

INDIAN MUNITIONS BOARD

Review of the Trade in Indian Hides, Skins and Leather

Published by order of the Government of India

SOLD AT THE
OFFICE OF THE SUPERINTENDENT GOVERNMENT PRINTING, INDIA
8, HASTINGS STREET, CALCUTTA

1915

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PREFACE

THE object of this memoir is to review the trade in Indian hides and skins and the Indian leather industry in the period preceding the war, to describe the effect of the war on the different branches of the trade and to indicate the opportunities for development which have arisen. The history of the pre-war period is dealt with separately in Part I and the war period up to the 31st March 1918 in Part II.

In Part III is republished an account of the results of recent research in Indian tanning materials by Mr. W. A. Fraymouth, Director of the Government Tannin Research Factory, Maihar, and Mr. J. A. Pilgrim, Tannin Expert to Government. A note by the latter officer has also been included on the prospects of tannin extract manufacture in India.

The Review thus attempts to bring together in a convenient form the principal statistics of the trade and to make available for the public the experience acquired by the Indian Munitions Board under war conditions. The Board intends to publish a further memoir by Captain A. Guthrie, Deputy Controller, Hides, Madras, which will contain a technical description of the different methods of tanning practised in India.

While this Review was in Press the Imperial Institute, London, published the results of its investigations into the Indian Hides and Skins trade in Bulletin No. 2 of 1918 (John Murray, 2s. 6d.).

CALCUTTA

23rd. December 1918.

A. C. McWATTERS,

Controller, Hides, Indian Munitions Board.

INDIAN MUNITIONS BOARD

Review of the Trade in Indian Hides, Skins and Leather

PART I

The Pre-War Period.

CHAPTER I.

INTRODUCTORY.

This review takes account only of the trade in hides of cattle, *i.e.*, oxen, cow and buffalo, and in skins of goat and sheep and leather made therefrom. It does not deal with hides and skins of other animals, such as deer, *nilgai*, etc., which, although utilized in considerable quantities in India, are of much smaller importance.

The growth of the trade in hides and skins can be realised at a glance from the export figures, which are summarised in the table on page 2 for five-year periods from 1880-81 to 1914-15.

The figures for the year 1913-14, which are given separately below, are the highest recorded for the pre-war period.

TABLE I.—*Exports in 1913-14.*

	Quantity in cwts.	Value in Rs. ('000)
Raw hides	1,115,747	8,29,60
Tanned hides	174,028	1,58,79
Raw skins	486,563	3,39,04
Tanned skins	130,593	2,63,79
Total	1,906,931	15,91,22

TABLE II.—Exports of hides and skins, raw and tanned, from British India by sea to foreign countries
for five-year periods.

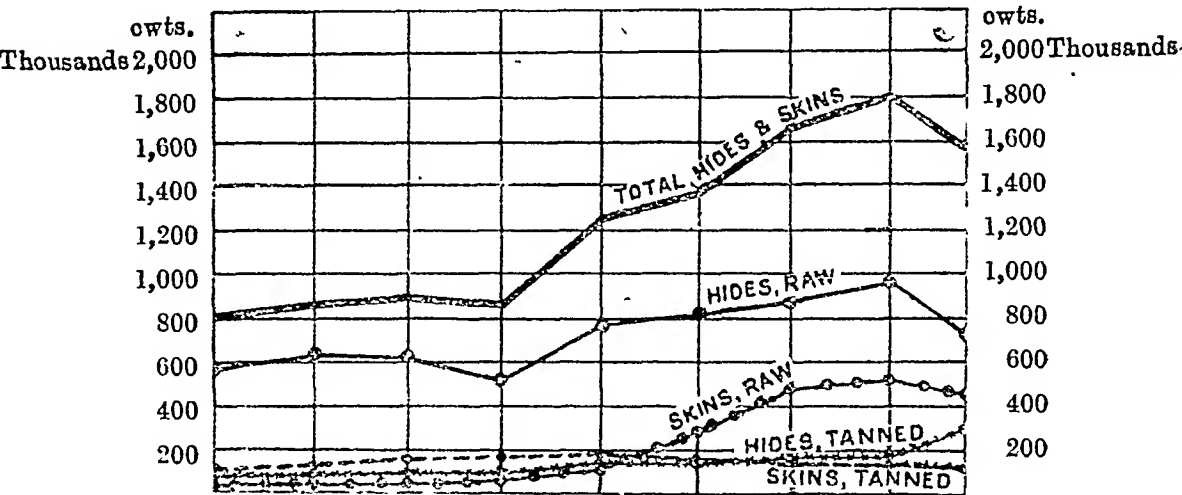
Average annual exports for period	QUANTITY IN CWTs.				VALUE IN RS. ('000.)					
	Hides, raw.	Hides, tanned.	Skins, raw.	Skins, tanned.	Total.	Hides, raw.	Hides, tanned.	Skins, raw.	Skins, tanned.	Total.
1880-81 to 1884-85	626,250	87,975	40,167	129,480	883,878	2,06,80	48,63	27,35	1,51,65	4,34,48
1885-86 to 1889-90	617,104	99,732	41,688	164,197	922,811	2,11,27	53,56	33,91	1,93,34	4,92,08
1890-91 to 1894-95	508,414	98,840	80,006	189,591	877,541	1,81,36	55,49	67,90	2,48,96	5,56,71
1895-96 to 1899-1900	786,544	144,724	120,139	191,553	1,245,960	3,27,99	83,77	1,20,02	2,85,63	8,17,41
1900-01 to 1904-05	802,698	144,580	200,721	159,545	1,373,544	3,60,80	86,07	2,59,05	2,33,87	9,39,79
1905-06 to 1909-10	863,449	180,769	430,649	143,006	1,667,873	5,17,48	1,42,46	4,03,20	2,58,67	13,22,81
1910-11 to 1914-15	967,141	190,400	506,682	134,826	1,799,049	6,50,61	1,76,00	3,33,36	2,66,85	14,35,82

CHART No. I.—*Illustrating exports of hides and skins, raw and tanned, from British India by sea to foreign countries for five year periods from 1875-76.*

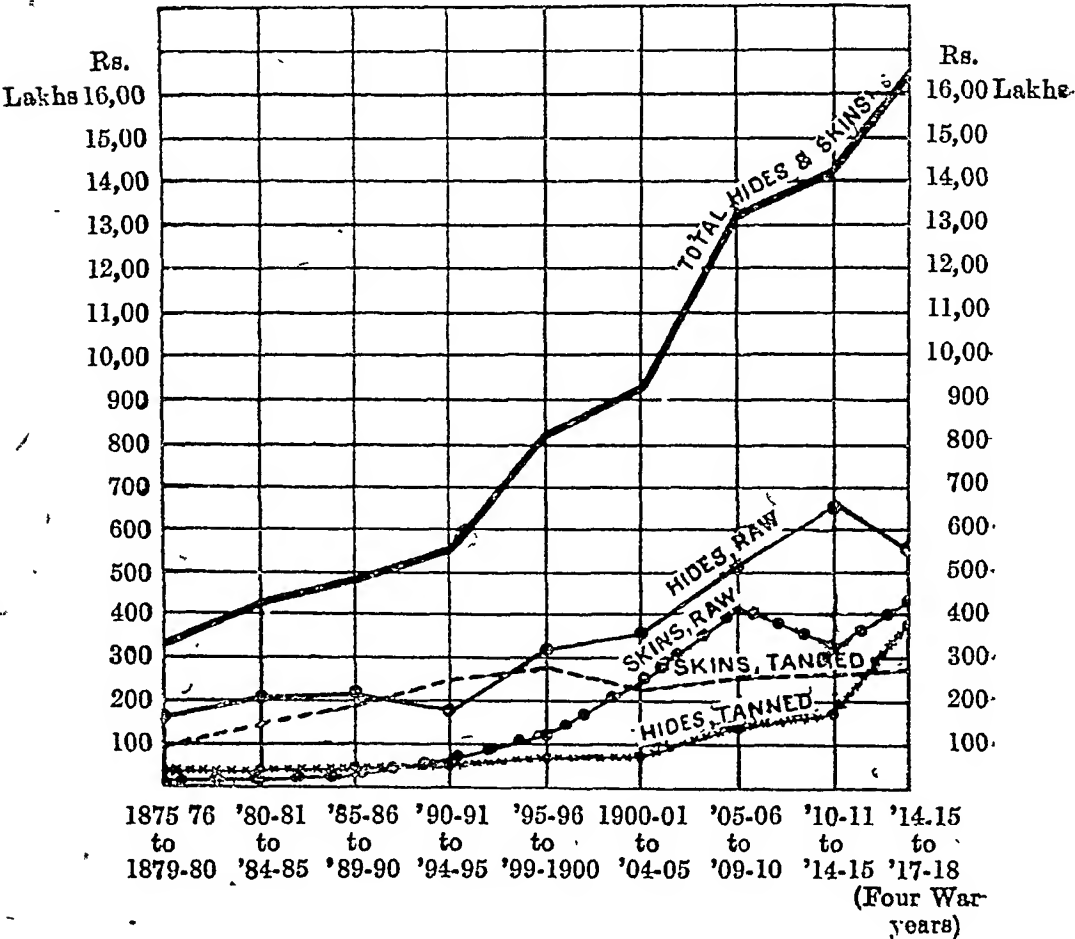
(To follow Table No. II.)

(A) QUANTITY
(In thousands of cwts.) (Four War years)

1875-76 '80-81 '85-86 '90-91 '95-96 1900-01 '05-06 '10-11 '14-15
to to to to to to to to to
1879-80 '84-85 '89-90 '94-95 '99-1900 '04-05 '09-10 '14-15 '17-18



(B VALUE
(In lakhs of Rs.)



We are thus dealing with an export trade which before the war had reached a value of £10½ millions, and in addition we have to take account of the large quantities of hides and skins which are retained in India and tanned for local consumption. It has been estimated that about nine-tenths of the goat and sheep skins and 50 per cent. of the cattle hides which become available each year in India are exported, but this estimate is only approximate, since accurate figures are not available of the number of cattle and goat and sheep which die or are slaughtered each year or even of the agricultural stock existing in the country.

The figures of agricultural stock given in Volume I of the Statistics of British India are admittedly incomplete. In 1916-17, the latest year for which figures have been published, the numbers recorded for British India are :—

Bulls and bullocks	49,416,156
Cows	37,616,899
Buffalos, bull	5,581,163
„ cow	13,698,584
Young stock (calves and buffalo calves)	43,112,218
TOTAL CATTLE	149,425,020
Sheep*	22,923,458
Goats*	33,366,392

Returns are available also for nineteen Indian States, comprising 106 million acres out of the 497 million acres under the rule of Indian Chiefs. The figures given for these nineteen States are :—

Cattle	14,704,000
Sheep and goats	8,960,000

We may therefore safely accept as a minimum the figures adopted in Appendix D to the Report of the Indian Industries Commission, *viz.*, 180 million cattle and 87 million goats and sheep as an estimate of the total stock existing in India. If comparison be made with the figures for previous years recorded in Volume I of the Statistics of British India, there will appear to have been an increase in the agricultural stock of about 50 per cent. within ten years. Making every allowance for the uncertainty of the statistics, we are at any rate justified in concluding that the notable expansion of the export trade in hides and skins has been com-

* Figures for sheep and goats are exclusive of Bengal, for which the returns are incomplete.

patible with an increase in the agricultural stock of the country.

We may now consider the trade in hides, skins and leather, as it existed prior to the war, under each of the following natural subdivisions:—(a) raw hides and raw skins, (b) tanned hides and tanned skins, and (c) finished leather and leather manufactures.

CHAPTER II.

THE RAW HIDES TRADE BEFORE THE WAR.

It is not proposed to give here a complete description of the Indian raw hide trade. For fuller details reference can be made to the provincial monographs,* and to the account prepared by Mr. J. C. K. Peterson, I.C.S., for the Indian Industries Commission, (Volumes of Evidence). A short description of the trade is, however, necessary for a proper understanding of what follows.

There are three main classifications of cow-hides based on the method adopted for preserving the hides, (a) wet-salted, (b) dry-salted, and (c) air-dried or arsenicated. The wet-salted hides are prepared in this form for immediate use by tanners. Wet-salted hides are not exported except to a small extent from Burma.

Dry-salted hides come principally from the damp regions in the north-east of India, where they are prepared at all seasons of the year. Dacca is the principal centre in eastern Bengal, while hides from middle and western Bengal are known as Meherpores or Daissies. Dacca hides are frequently heavily adulterated, while the "real Meherpore" standard of cure, in which the hides are cleanly fleshed and salted just sufficiently to preserve the hides, is regarded as the proper standard of cure for dry-salted hides. Very few "Real Meherpores" are available.

* NOTE—The following provincial monographs have been published on the leather industry :—

Monograph on the leather industry of the Punjab, 1891-92; by A. J. Grant.

Monograph on tanning and working in leather in the United Provinces of Agra and Oudh; by H. G. Walton. 1903.

Monograph on tanning and working in leather in the Central Provinces; by C. G. Chenevix Trench. 1904.

Tanning and working in leather in the Province of Bengal; by R. N. L. Chandra. 1904.

Monograph on tanning and working in leather in the Province of Burma; by E. J. Colston. 1904.

Monograph on tanning and working in leather in the Madras Presidency; by A. Chatterton. 1905.

Report on leather industries of the Bombay Presidency; by A. Guthrie. 1910.

The subject is also dealt with in the Report on the Industrial Survey of the Central Provinces, 1908-09, and the Handbook of Commercial Information, Madras, by M. E. Couchman, 1916.

The air-dried system is prevalent in the north-west and all the drier parts of India during the cold weather and summer months. During the monsoon this method of treatment is impracticable in the greater part of the country. Air-dried hides include hides from the Punjab and Sind; North-Westerns and Agras, in which are classed also hides from the Eastern Punjab and Delhi and from parts of the Central Provinces, while further east, Patnas, Durbungas and Purneahs are among the varieties distinguished. Air-dried hides from Central India include the Ranchi and Sambalpur varieties. A number of the best hides from Northern India are dried by stretching on frames and are known as Firmas or framed hides. Air-dried hides are usually preserved by dipping them in a solution of arsenic—hence the term ‘arsenicated.’ They are usually re-arsenicated at the ports before export.

This classification does not by any means exhaust all the varieties of hides distinguished by the trade, but it includes the more important classes distinguished by exporters.

Hides are further subdivided into (1) slaughtered, (2) deads, (3) rejections, (4) double rejections. The “slaughtered” class includes the best hides of animals which have died through natural causes. The proportion of hides which comes from animals actually killed for food is small because only a small fraction of the Indian people will eat meat and there is a strong feeling against the slaughter of cattle. In recent years, however, a considerable trade has grown up in the export of jerked meat to Burma, and slaughter-houses exist to supply this trade at Agra, Damoh, Rahatgarh, Khurai and other places. Slaughter-houses also exist in all the big cities and in military cantonments. It is from the latter that the best class of slaughtered hides from Northern India have become known as “Commissariats.”

For the export trade hides are also subdivided into various ranges of weights.

The description given above indicates only the main lines of classification, since before the war the principal exporting houses had greatly elaborated the above classifications and shipped, mainly for the continental trade, under a variety of special marks. It may be said generally that the careful assortment of hides takes place only after they have reached the exporter. The organisation for collection of hides up-country is still of a primitive character.

and the original owner of the hide has usually no great pecuniary inducement to see that it is properly flayed and preserved. The hide passes through the hands of several middlemen or 'beoparis' before it reaches the 'arathdar,' or commission agent, who sells to the exporter or tanner.

The table on pages 8 and 9 which follows gives the figures of exports of raw hides from British India, showing both quantity and value, from the year 1880-81 to the last complete pre-war year 1913-14. Calcutta is the principal port for exports of all classes of raw hides. Karachi is the second largest exporting centre, but exports only arsenicated hides from the Punjab and Northern India. Burma hides are exported from Rangoon.

An analysis of this table shows that there was a marked increase both in the quantity and value of the trade in the second half of this period. The average value per cwt. also, which was only Rs. 33 in the first five years, 1880-81 to 1884-85, had risen to Rs. 68 in the five years preceding the war. The exceptional figures for particular years, such as 1899-1900 and 1900-01, are due to the fact that these were years of famine in Northern India. In famine years there is always a heavy mortality among cattle.

The great increase in exports during the three years immediately preceding the war is accounted for by the large purchases of Indian hides made by Germany and Austria and also by the United States of America.

The destinations of the exports of raw hides from British India can be studied in a convenient form in the table on page 10.

This table illustrates the well-known story of the loss of the Indian hides trade by the United Kingdom and its capture by Germany and Austria. During the period 1879-80 to 1883-84 the United Kingdom took 64 per cent. in value of the total exports; the United States of America took 14.1 per cent. and Italy 10.7 per cent. In that period Germany took nothing and Austria only 4.7 per cent. Subsequently, the United Kingdom's share decreased until in the five years before the war it was only 4.6 per cent. On the other hand Germany's share increased rapidly from 1890 onwards: in the five years before the war she took 37 per cent. of the total exports and Austria's share in the same period was 19.6 per cent. The

TABLE III.—Exports of raw hides from British India by sea to foreign countries. (See also Tables VIII and XXI.)

	QUANTITY IN CWTs.						VALUE IN Rs. ('000.)									
	United Kingdom.	Italy.	United States.	France.	Austria.	Germany.	Other countries.	Total.	United Kingdom.	Italy.	United States.	France.	Austria.	Germany.	Other countries.	Total.
1880-81	368,970	63,365	111,170	15,735	20,954	..	14,950	595,144	1,24,09	21,06	25,75	5,16	7,67	..	3,76	1,87,49
1881-82	334,798	62,877	87,871	23,865	31,456	..	25,318	566,185	1,13,74	23,08	18,40	8,08	11,21	..	6,52	1,81,03
1882-83	352,991	47,483	104,257	20,536	19,188	..	49,393	593,848	1,25,52	17,33	23,76	6,99	7,56	..	13,45	1,94,61
1883-84	384,140	72,493	106,094	16,820	32,091	..	30,785	642,423	1,38,13	27,21	25,62	6,02	12,99	..	8,58	2,13,55
1884-85	417,636	96,593	116,987	15,420	42,463	1,588	42,965	733,652	1,54,17	36,18	29,09	5,32	15,92	64	10,99	2,52,31
1885-86	402,069	100,863	168,909	26,894	29,088	5,107	50,709	783,639	1,47,53	36,96	43,35	9,87	10,60	1,93	13,59	2,63,83
1886-87	388,165	70,453	122,551	21,369	33,147	13,038	62,387	711,110	1,41,80	28,02	34,84	7,69	13,03	5,17	18,54	2,49,09
1887-88	321,809	48,929	88,765	13,427	41,074	4,054	52,785	570,843	1,21,58	19,27	24,05	4,40	16,76	1,08	14,46	2,02,20
1888-89	311,349	53,105	77,495	25,279	29,928	6,321	30,277	533,754	1,05,63	19,14	20,82	8,15	11,39	2,29	7,33	1,74,75
1889-90	241,010	77,596	58,329	30,614	14,209	32,614	32,254	486,636	88,37	20,02	15,12	9,25	5,34	12,10	7,29	1,66,49
1890-91	191,857	62,372	55,029	24,197	21,724	110,148	27,226	492,553	69,85	22,52	15,97	8,54	8,12	38,73	5,81	1,69,54
1891-92	126,032	54,534	53,487	36,342	20,162	192,994	20,131	503,682	41,98	20,06	16,13	13,11	7,18	68,92	5,01	1,72,39
1892-93	84,585	63,237	39,425	37,702	33,016	188,028	25,986	472,629	32,74	24,54	11,48	14,00	13,17	72,16	7,46	1,76,15
1893-94	104,378	84,785	25,032	40,775	39,932	173,715	36,312	504,929	41,00	33,56	8,80	17,75	14,89	68,04	10,81	1,94,85
1894-95	101,399	97,596	48,037	43,140	29,397	213,914	34,706	598,279	37,30	38,17	13,76	18,25	11,30	90,59	9,52	2,08,89
1895-96	117,951	69,005	87,399	65,072	33,756	227,241	49,411	649,835	46,55	29,67	23,30	29,77	14,55	97,22	14,97	2,61,03

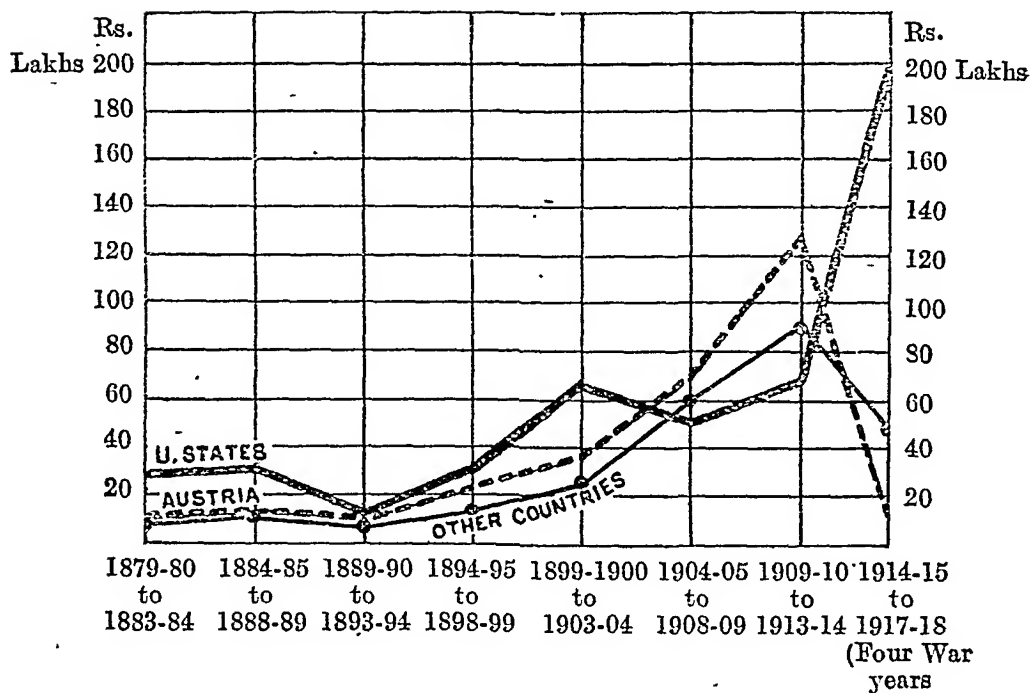
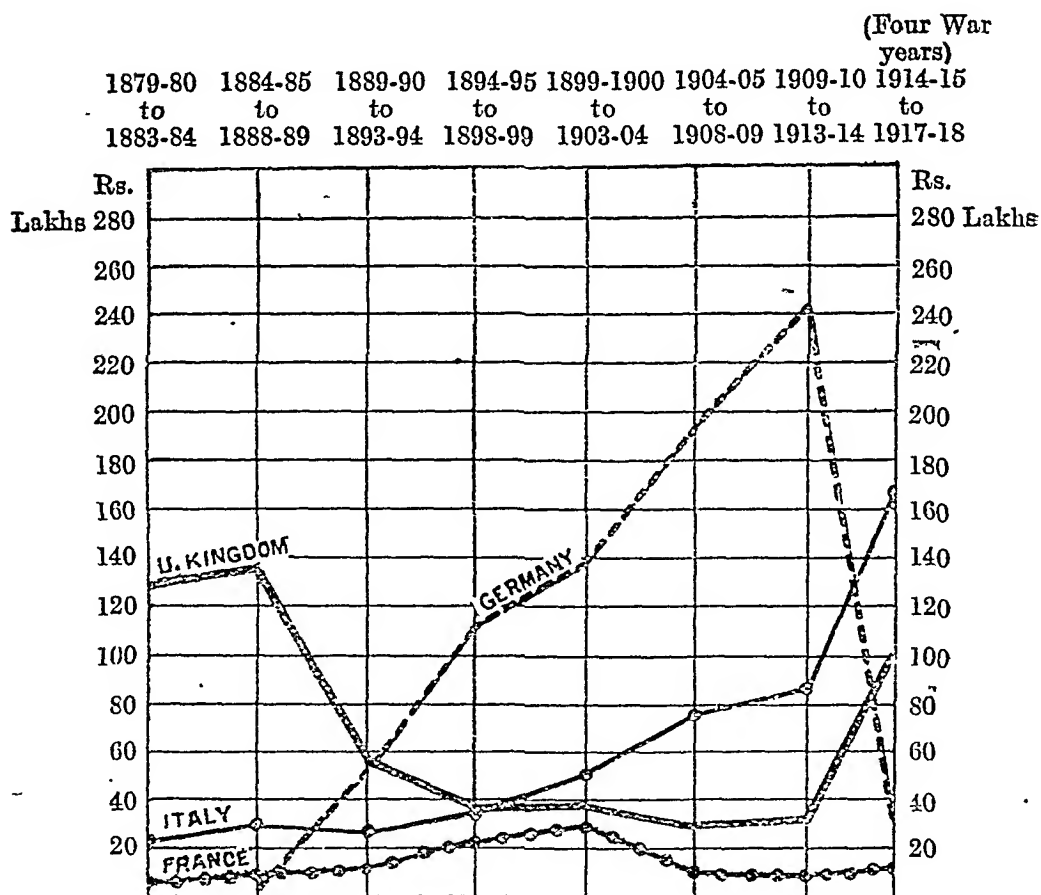
1896-97 .	83,325	60,886	69,997	40,618	44,806	238,328	53,903	591,813	34,93	27,92	24,22	21,08	20,03	1,08,76	10,56	2,54,10
1897-98 .	80,678	92,132	132,488	48,239	83,318	326,649	42,844	806,348	29,99	42,03	45,84	20,65	36,25	1,42,06	14,67	3,37,49
1898-99 .	75,127	90,897	97,685	31,144	63,838	292,633	44,634	695,958	31,23	41,25	35,97	10,27	27,53	1,26,06	16,49	2,94,85
1899-1900 .	183,976	132,562	294,303	123,315	71,166	334,760	48,083	1,188,765	08,64	58,94	1,13,97	57,76	30,96	1,44,23	18,00	4,92,50
1900-01 .	254,297	132,505	257,580	59,103	108,174	423,133	47,838	1,282,630	84,03	63,23	96,36	30,28	47,16	1,88,04	17,52	5,26,62
1901-02 .	33,030	96,594	143,230	35,202	74,783	248,016	48,638	679,493	11,52	45,08	56,03	18,90	32,82	1,05,67	17,97	2,87,99
1902-03 .	37,408	74,021	94,994	46,678	85,401	255,773	76,970	671,314	12,36	35,78	37,80	26,29	38,82	1,17,04	33,17	3,01,76
1903-04 .	39,900	98,850	69,905	35,587	82,009	263,479	80,462	670,792	15,41	49,98	28,45	10,39	38,92	1,26,08	37,92	3,16,75
1904-05 .	49,444	111,249	94,953	14,060	99,377	264,090	75,488	709,261	22,31	65,93	40,80	8,08	51,64	1,44,45	37,16	3,70,87
1905-06 .	73,796	123,688	144,236	21,184	116,456	350,992	113,729	944,081	37,52	79,58	72,01	11,98	65,44	2,01,49	55,36	5,23,38
1906-07 .	74,228	125,843	154,707	31,847	165,061	401,260	138,228	1,091,174	39,53	92,02	78,23	18,20	94,70	2,37,75	80,47	6,40,90
1907-08 .	41,009	73,984	60,972	9,556	102,311	283,959	97,025	679,716	22,71	56,37	30,58	5,77	67,22	1,88,14	61,19	4,31,98
1908-09 .	38,873	115,580	86,456	7,372	109,295	315,118	92,372	765,066	19,65	79,03	40,93	5,23	70,11	1,97,00	66,53	4,78,48
1909-10 .	61,011	94,003	74,757	8,199	141,896	338,541	118,801	837,298	30,97	70,10	35,85	4,92	91,25	2,03,08	76,49	5,12,66
1910-11 .	41,633	118,776	48,326	6,584	170,299	341,433	125,015	852,066	20,29	89,85	24,01	4,21	1,09,42	2,16,08	75,82	5,39,68
1911-12 .	60,348	102,200	59,146	17,508	219,892	342,053	143,680	944,917	31,80	73,79	34,14	7,28	1,40,86	2,24,12	85,81	5,97,80
1912-13 .	83,799	133,164	228,281	25,584	173,772	389,429	175,020	1,209,049	44,94	1,01,05	1,45,62	14,51	1,17,91	2,67,53	1,14,30	8,95,86
1913-14 .	42,366	106,805	155,372	17,885	237,829	388,409	167,082	1,115,747	24,85	84,46	1,04,67	10,42	1,84,41	3,06,61	1,14,18	8,29,60

TABLE IV.—Average annual exports of raw hides from British India by sea for five-year periods.

Destination of exports from British India	1879-80 to 1883-84.		1884-85 to 1888-89.		1889-90 to 1893-94.		1894-95 to 1898-99.		1899-1900 to 1903-04.		1904-05 to 1908-09.		1909-10 to 1913-14..	
	Value in ₹ ('000.)	Per-centage of total exports.	Value in ₹ ('000.)	Per-centage of total exports.	Value in ₹ ('000.)	Per-centage of total exports.	Value in ₹ ('000.)	Per-centage of total exports.	Value in ₹ ('000.)	Per-centage of total exports.	Value in ₹ ('000.)	Per-centage of total exports.	Value in ₹ ('000.)	Per-centage of total exports.
United Kingdom ^①	1,27,28	64.0	1,34,14	58.7	54,70	31.2	36,00	13.3	38,49	10.0	28,44	5.8	30,57	4.6
Italy . . .	21,36	10.7	27,91	12.2	25,94	14.7	35,80	13.2	50,00	13.1	74,50	15.3	83,85	12.8
United States of America . . .	28,04	14.1	30,43	13.3	13,50	7.7	29,62	10.9	66,52	17.3	52,51	10.7	68,86	10.5
France . . .	5,82	2.9	7,09	3.1	12,05	7.2	22,40	8.3	30,52	7.9	9,85	2.0	8,27	1.3
Austria . . .	9,36	4.7	13,54	5.9	9,74	5.5	22,06	8.1	37,74	9.8	69,82	14.3	1,28,77	19.6
Germany . . .	Nil.	..	2,34	1.1	51,99	29.6	1,10,94	40.9	1,30,33	35.4	1,93,77	39.6	2,43,48	37.0
Other Countries . . .	7,11	3.6	12,98	5.7	7,28	4.1	14,44	5.3	24,92	6.5	60,14	12.3	93,32	14.2
Total	1,98,97		2,28,43		1,75,89		3,71,26		3,85,12		4,89,12		6,57,12	

CHART No. II.—*Illustrating the direction of exports of raw hides from British India for five year periods from 1879-80.*

(To follow Table IV.)



Central Empires thus before the war took 56·6 per cent. of the total trade, with an annual value of Rs. 3,72,25,000. The proportions taken by Italy (12·8 per cent.) and the United States of America (10·5 per cent.) were also considerably greater than the share remaining to the United Kingdom.

The diversion of this trade from British to Continental tanners coincides with the development of the chrome tanning industry in Germany, where Indian hides were mostly treated by the chrome process. It was also greatly helped by Germany's tariff policy which, while allowing free import to raw hides, imposed progressively increasing duties on imported leather. This duty in 1876 was equivalent to 6s. 1d. per cwt., *i.e.*, approximately 6 per cent. *ad valorem*. Two years later it was increased to 10 per cent., and in 1906 it was again raised, a specific duty being imposed which varied from 1½d. to 2¾d. per lb. Special shipping advantages were also given for the export of raw hides from India direct to Hamburg and Bremen, and the German hold on the trade was consolidated by a combination in Calcutta of the seven principal exporting firms, all of which were either German or possessed strong German connections. The hides exported from India to Germany were used there primarily for making upper leather for army boots. Of the balance at least half was suitable for civilian upper leather (a large part of which came back to England in the form of box calf) and for making soles for light boots and shoes.

The sea-borne trade statistics of the United Kingdom and Germany afford a significant commentary on the changed direction of the trade.

TABLE V.—*Exports of hides and leather from the United Kingdom to Germany.*

	(VALUE IN £.)		
	Leather, wrought and un- wrought.	Hides, un- tanned.	Hides, tanned, dressed and curried.
1890	335,918	265,582	260,489
1900	413,776	301,503	238,373
1910	610,442	201,275	683,447
1913	624,309	264,814	759,843

TABLE VI.—*Exports of hides and leather from Germany to the United Kingdom.*

	(VALUE IN £)	
	Hides undressed.	Leather.
1890	168,043	292,341
1900	241,358	564,342
1910	251,706	2,233,364
1913	158,188	3,151,648

The Indian sea-borne trade returns do not distinguish separately between cow-hides and buffalo-hides until the year 1912-13. The figures for the separate classes recorded in 1912-13 and 1913-14 are given in the table on page 13.

Exports of raw cow-hides and buffalo hides separately recorded.

This table shows that Germany's interest was much greater in the cow-hide than in the buffalo hide trade. In the latter the United States of America was easily first, followed by Austria. In the cow-hide trade Germany, Austria and Italy were predominant. Among the "other countries" not separately recorded in the preceding tables, the most important buyers of Indian hides were Spain, Holland and Belgium.

The table given on pages 8 and 9 shows how the value of Indian hides has appreciated. The following table which has been compiled from records of prices actually paid by one of the leading firms in the Calcutta market shows the general level of raw cow-hide prices in recent years.

Prices of raw hides in India.

TABLE VII.—*Calcutta market prices for raw cow-hides quoted in Rupees per 20lbs. (See also Table XXIII).*

Date.	RAW COW-HIDES, ARSENICATED.				RAW COW-HIDES, DRY-SALTED.	
	Agras 9 to 10 lbs.	North- Westerns, 9 to 10 lbs.	Durbun- gahs, 8 to 9 lbs.	Patnas 9 to 10 lbs.	Daccas 9 to 11 lbs.	Daissies 8 to 10 lbs.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
January, 1909 .	14 8 0	12 8 0	10 8 0	7 12 0	...	...
" 1910 .	17 0 0	14 8 0	10 12 0	8 0 0	...	...
" 1911 .	14 8 0	12 8 0	11 0 0	7 8 0	10 0 0	9 0 0
" 1912 .	15 8 0	14 4 0	11 8 0	7 12 0	10 4 0	9 12 0
" 1913 .	16 4 0	14 8 0	12 0 0	8 0 0	11 0 0	10 0 0
" 1914 .	18 8 0	16 4 0	12 8 0	10 12 0	...	...

TABLE VIII.—Exports of raw buffalo hides, cow-hides and calf skins from British India by sea to foreign countries in 1912-13 and 1913-14. (See also Tables III and XXI).

	QUANTITY IN CWTs.							VALUE IN £ ('000.)								
	United Kingdom.	Italy.	United States.	France.	Austria.	Germany.	Other countries.	Total.	United Kingdom.	Italy.	United States.	France.	Austria.	Germany.	Other countries.	Total.
Buffalo Hides, raw—																
1912-13	40,551	10,921	143,766	6,646	58,276	22,148	56,729	345,037	23,10	6,13	82,05	3,11	35,30	13,01	27,21	1,89,91
1913-14	26,254	7,150	114,476	3,232	91,736	30,785	72,231	345,864	14,94	4,25	77,11	1,44	60,93	20,15	35,85	2,20,37
Cow Hides, raw—																
1912-13	35,076	110,095	69,434	17,844	113,620	365,874	113,257	831,200	20,56	90,66	54,73	10,83	81,39	2,53,90	83,39	5,95,46
1913-14	14,919	92,662	36,820	14,283	141,587	356,105	86,621	743,037	9,42	75,20	25,80	8,78	1,14,51	2,85,47	71,37	5,90,55
Calf skins, raw—																
1912-13	1,394	5,890	14,921	621	1,516	404	4,894	29,640	98	4,07	8,73	37	97	26	3,62	19,00
1913-14	913	6,822	4,076	306	4,556	1,213	8,230	26,116	69	4,90	1,76	15	2,96	86	6,99	18,31

The sharp rise in prices between 1912 and 1914 is directly attributable to the heavy buying which took place before the war.

A similar rise took place in prices of raw buffalo hides. An average price in 1908-1909 would have been about Rs. 9 to 10 per 20 lbs for Agras arsenicated. Prices rose sharply about the last quarter of 1912 and from the middle of 1913 till the outbreak of the war prices for similar qualities were about Rs. 12 to Rs. 12-8.

CHAPTER III.

THE RAW SKINS TRADE BEFORE THE WAR.

The development of an export trade in raw skins, particularly in raw goat skins, has been one of the important features of the Indian export trade since about the year 1890. Prior to that year the export of raw skins from India was comparatively unimportant, but with the development of chrome tanning for the production of glacé kid, manufacturers began to search the world for raw material and in the Indian goat skin was found one of the most important sources of supply. It has been calculated that India produces about one-third of the world's exportable surplus of goat skins. Other important exporting countries are China, South Africa, Aden, the Argentine, Brazil, Mexico, Russia, Morocco and Turkey. The general development of the trade is illustrated by the following table which gives the annual average exports of raw skins from British India for five-year periods from the year 1880-81 :—

TABLE IX.—*Average annual exports of raw goat and sheep skins from British India by sea for five-year periods.*

	Quantity in cwts.	Value in (Rs. '000)
1880-81 to 1884-85	40,167	27,35
1885-86 to 1889-90	41,688	33,91
1890-91 to 1894-95	80,696	67,90
1895-96 to 1899-1900	120,139	1,20,02
1900-01 to 1904-05	266,721	2,59,05
1905-06 to 1909-10	480,649	4,03,20
1910-11 to 1914-15	506,682	3,33,36

By far the greater part of these exports consisted of raw goat skins. Separate figures for goat and sheep skins have been recorded in the British India sea-borne trade returns since 1905-06 and are given on page 16.

TABLE X.—Exports of raw goat and sheep skins from British India by sea to foreign countries. (See also Table XXIV).

	QUANTITY IN CWTs.							VALUE IN RUPEES ('000.)								
	United Kingdom.	United States.	Italy.	France.	Austria.	Germany.	Other countries.	Total.	United Kingdom.	United States.	Italy.	France.	Austria.	Germany.	Other countries.	Total.
Goat skins, raw—																
1905-06 . . .	42,893	368,785	1,081	50,306	2,639	20,940	14,083	500,727	37,13	3,49,03	92	45,06	2,44	10,31	13,51	4,58,40
1906-07 . . .	50,133	294,058	..	21,863	234	8,489	11,785	386,562	46,53	2,97,50	..	23,00	44	5,37	11,51	3,84,36
1907-08 . . .	29,744	218,122	..	19,255	27	2,622	12,451	281,221	22,90	1,92,97	..	16,79	4	2,81	11,53	2,47,04
1908-09 . . .	39,215	374,015	..	18,181	107	2,351	14,408	448,277	23,77	2,78,79	..	16,45	10	1,93	14,33	3,35,37
1909-10 . . .	37,225	479,904	147	27,947	811	7,781	25,318	579,133	26,55	3,42,49	11	25,92	80	7,97	21,44	4,25,28
1910-11 . . .	41,132	390,361	85	37,471	607	7,724	31,573	508,953	24,61	2,44,87	6	32,17	58	7,03	23,84	3,33,16
1911-12 . . .	38,837	379,214	32	26,472	535	7,924	28,293	481,307	20,06	2,40,46	2	21,36	67	7,23	22,52	3,12,32
1912-13 . . .	56,287	381,266	15	35,659	1,295	12,504	33,928	520,954	30,85	2,44,28	1	27,28	1,37	11,54	26,46	3,41,79
1913-14 . . .	40,259	342,452	18	22,717	1,262	11,118	35,530	453,356	20,84	2,27,54	3	18,50	1,73	10,55	33,58	3,12,77
Sheep skins, raw—																
1905-06 . . .	2,762	5,239	458	683	193	4,589	1,037	14,961	2,36	4,80	27	44	17	3,49	1,11	12,64
1906-07 . . .	8,613	8,497	1,153	1,654	643	12,621	2,190	35,371	7,45	8,07	80	1,41	64	11,63	1,56	31,56
1907-08 . . .	2,008	8,555	..	3,031	..	885	526	15,005	1,80	7,07	..	3,13	..	1,10	46	13,56
1908-09 . . .	1,179	4,266	9	1,099	..	1,615	1,124	9,292	83	2,69	..	37	..	1,40	75	6,04
1909-10 . . .	848	12,999	34	479	34	1,047	1,035	16,476	73	8,51	3	31	2	71	77	11,08
1910-11 . . .	172	16,744	378	1,287	8	4,234	673	23,496	16	10,06	19	61	..	2,92	46	14,40
1911-12 . . .	642	23,200	54	3	20	2,523	1,888	28,330	44	15,52	5	..	2	1,91	1,08	19,02
1912-13 . . .	1,081	28,986	49	283	26	714	529	31,668	81	21,45	5	12	2	48	33	23,29
1913-14 . . .	4,599	28,818	120	85	123	1,676	646	33,067	1,41	22,69	14	6	8	1,05	67	26,10

From this table will be seen the very large proportion of the trade in Indian raw goat skins taken by the United States of America. There were appreciable exports to the United Kingdom and France. The United States also took the largest share of the raw sheep skins.

Unlike Indian hides, Indian skins are mostly obtained from animals which have been slaughtered for food. They are therefore relatively much superior in quality to Indian hides. For export purposes Indian skins are mostly dry-salted with the hair on, but sometimes they are flint-dried and occasionally wet-salted in the hair or unhaired and then pickled in a solution of alum and salt. Each firm has its own standard for sorting into firsts, seconds, etc., The more important varieties of goat skins are distinguished by the names of the areas from which they come. The following are among the principal varieties:—Daccas, Dinajpores, Durbangas, Mozaffarpores, North-Westerns, Amritsars. The last-named is a trade term for the large-sized goat skins from this and other Punjab districts. North-Westerns are also large skins, giving from 80 to 120 feet of leather per dozen. Skins from Bombay, Madras, Hyderabad and the Deccan are mainly used by the Madras and Bombay tanneries.

Prices of raw skins remained fairly steady in the six or seven years before the war, and there was no sharp upward rise in 1913-14, such as occurred in the prices of raw hides. A typical price for Patna goat skins per 100 pieces during the pre-war period would have been about Rs. 100 to 130.

CHAPTER IV.

THE TANNED HIDES AND SKINS TRADE BEFORE THE WAR.

The export trade in tanned hides and skins is a special feature of the Madras and Bombay Presidencies, particularly the former, and the adjoining Indian States. The location of this trade in these parts is unquestionably due to the prevalence there of the shrub *Cassia auriculata* (Native names, *Avaram*, *Avla* or *Turwad*), the bark of which is the principal tanning material used in preparing these hides and skins for export. The leather produced is a light tannage or 'half-tan,' soft and plump and light coloured and very suitable for subsequent treatment by the currier or dresser. The tanneries work almost wholly without the aid of machinery, but the leather is of its class extremely good, and we may quote in this connection the opinion of the Government leather expert at Madras who writes:—"The methods employed by these export tanners, when carried out under the best conditions as regards water, bark and Myrabolans and careful supervision, turn out a class of leather that is of very high quality, very suitable for European and American leather dressers, and although several tanners have at different times tried to modernize the processes used, they have always returned to the old native methods."

Statistics have recently been collected of the number of tanneries working in the Madras and Bombay Presidencies, which give a good idea of the extent and distribution of this industry. Many of the tanneries work with both hides and skins and these are designated as "mixed tanneries" in the table given below. In normal times the figures for labour in skin tanneries in the districts of Trichinopoly and Madura, where Dindigul is the most important centre, would be larger, as some of the principal tanners in those districts—who usually tan skins only—are not at present working to their full capacity.

TABLE XI.—*Distribution of Madras tanneries.*

Name of District.	HIDE TANNERIES.		SKIN TANNERIES.		MIXED TANNERIES.		Total.	
	Number of tan-neries.	Average No. of labourers employed daily.	Number of tan-neries.	Average No. of labourers employed daily.	Number of tan-neries.	Average No. of labourers employed daily.	Number of tan-neries.	Average No. of labourers employed daily.
North Arcot . . .	72	1,716	23	802	31	1,004	126	3,522
Chingleput . . .	53	1,165	44	2,222	17	620	114	4,007
Kistna . . .	13	668	5	116	8	425	26	1,209
Vizagapatam . . .	7	565	1	55	4	145	12	765
Godavari . . .	6	298	2	71	2	190	10	559
Chittoor . . .	4	66	1	2	3	113	8	181
Bellary . . .	2	19	..	..	3	310	5	329
Ganjam . . .	2	65	..	..	2	70	4	135
South Arcot . . .	3	65	..	..	..	..	3	65
Guntur . . .	2	113	..	..	..	..	2	113
Kurnool . . .	1	84	..	..	1	126	2	210
Madras . . .	..	..	1	30	1	64	2	94
Nellore . . .	..	..	1	30	..	..	1	30
Cuddapah . . .	..	..	1	12	..	..	1	12
Madura . . .	9	164	17	844	10	266	36	1,274
Salem . . .	5	81	7	131	5	72	17	234
Tinnevely . . .	4	38	..	..	8	119	12	157
Tanjore . . .	2	16	1	30	..	..	3	46
Trichinopoly . . .	9	77	18	507	6	105	33	689
Coimbatore . . .	10	107	10	96	13	339	33	542
Total . . .	204	5,307	132	4,948	114	3,968	450	14,223

NOTE.—In several instances two or three adjoining tanneries working under the same management have been classed as one.

This list does not include the Chrome Leather Co.'s large tannery at Pallavaram, employing about a thousand labourers, which works both in bark and chrome tannages.

In Bombay Presidency, excluding Sir Adamjee Peerbhoy & Sons' large tannery at Sion, there are 27 tanneries employing 1,752 labourers daily, of which 16 are on the Bombay Island at Dharavi. The others are at Belgaum, Poona, Ahmedabad, Ahmednagar, Godhra, Navsari and Karachi. In Mysore State, in addition to the Mysore Tannery which works with chrome, there are more than 50 tanneries in the neighbourhood of Bangalore. There are a number of both hide and skin tanneries also in Hyderabad State, and several skin tanneries in Baroda State. A few small tanneries producing leather similar to the Madras and Bombay tannages have recently been started in the Central Provinces.

One of the earliest and best accounts of the Southern Indian tanned hide and skin industry is to be found in Mr. Chatterton's Monograph on tanning and working in leather in the Madras Presidency, 1905. Mr. Chatterton points out that the development

of the industry at first was slow, but a rapid expansion commenced in the middle of the seventies. This is attributable to various causes, the repeal of the export duty of 3 per cent. on tanned hides and skins in August 1875, the establishment of public auctions in London and the increasing demand for Indian skins in Germany. Last and perhaps most important was the completion of the main trunk lines of railways in India which enabled the Madras tanners to obtain supplies of raw materials from greatly extended areas.

South Indian tanned hides are known in the home markets as East India Tanned Kips. They are generally described by the names of various tracts, such as Bangalores, Coconadas, Hyderabad, Coasts, and so on. They are exported almost entirely to the United Kingdom, usually in execution of orders and under the special marks of the exporting firms located at Madras. A certain number, however, of the Madras tanned hides and all the Bombay tanned hides are sent on consignment to London where they are re-assorted and sold by auction. Hides are graded into Seconds, Thirds, Fourths, Fifths and Rejections. No grade of 'Firsts' is found in the hide trade, though 'Firsts' are distinguished in tanned skins. The great majority of the tanned skins are sent to the auction sales in London, where, however, a large proportion used to be taken by American and Continental buyers and re-exported. For instance in 1913, of the Indian tanned goat skins exported to the United Kingdom, 15 per cent. only were retained in the United Kingdom. Germany took 41.6 per cent. of the re-exports, and the United States 34 per cent. The same countries took a large proportion of the re-exports of tanned sheep skins, though the proportion retained in the United Kingdom was larger. A considerable quantity of tanned skins are also shipped direct from India to the United States, Japan and the Straits Settlements. Tanned skins, like tanned hides, are mostly distinguished by the names of particular tracts, *e.g.*, Trichinopolies, Coimbatore, Dindigul. Other classes are Prime Cities and Medium Cities.

The export figures of tanned hides from British India are given on pages 24 and 25 from the year 1880-81 to 1913-14.

Export statistics of tanned hides before the war.

This table illustrates the fluctuating nature of the trade, which has always been liable to considerable vicissitudes. The value of the exports during the earlier years will be seen to be very low and the trade has all along been exposed to the competition of the raw hide

exporter, whose activities constantly tended to raise the price of the raw material and prevented the South Indian tanners from obtaining any except local hides and the poorest selections from the Northern Indian hides. An increase in the quantity of tanned hides exported will be noted in famine years, such as 1895-96 and 1900-01.

The statistics given in the table on pages 24 and 25 include a small proportion of tanned buffalo hides. These were not separately recorded in the seaborne trade returns of British India until 1912-13. The buffalo hides tanned for export are almost wholly obtained from local supplies and are generally much lighter hides than those from North India.

TABLE XII.—*Exports of tanned cow and buffalo hides from British India by sea to foreign countries. (See also Tables XVI and XXV).*

	QUANTITY IN OWTS.			VALUE IN RS. ('000.)		
	United Kingdom.	Other Countries.	Total.	United Kingdom.	Other Countries.	Total.
Buffalo Hides, tanned—						
1912-13 .	14,707	2,300	17,007	9,84	1,95	11,79
1913-14 .	14,047	1,498	15,545	9,92	1,35	11,27
Cow Hides, tanned—						
1912-13 .	213,673	1,756	215,429	1,90,02	1,68	1,91,70
1913-14 .	155,550	2,833	158,383	1,44,60	2,80	1,47,40

The export statistics of tanned goat and sheep skins have been separately recorded in the sea-borne trade returns of British India since 1905-06, and are given on page 26.

By a curious anomaly in the Statistics of British India tanned calf skins are recorded among "Skins tanned—Other sorts," whereas raw calf skins are recorded under the export statistics for raw hides. (See page 13.) Consequently the following figures for exports of "Skins tanned—Other sorts" mainly relate to tanned calf skins, which it will be observed are exported principally to the United Kingdom in the same way as tanned hides.

TABLE XIII.—Exports of “tanned skins—other sorts”—from British India by sea to foreign countries. (See also Table XXIX.)

	QUANTITY IN CWTs.			VALUE IN RS. ('000.)		
	United Kingdom.	Other Countries.	Total.	United Kingdom.	Other Countries.	Total.
1905-06 . .	3,791	464	4,255	3,52	52	4,04
1906-07 . .	4,644	10	4,654	4,14	2	4,16
1907-08 . .	2,439	184	2,623	2,36	17	2,53
1908-09 . .	4,331	13	4,344	3,97	3	4,00
1909-10 . .	4,394	12	4,406	3,83	2	3,85
1910-11 . .	4,026	10	4,036	3,87	2	3,89
1911-12 . .	7,541	39	7,580	6,94	5	6,99
1912-13 . .	8,291	20	8,311	8,41	3	8,44
1913-14 . .	6,794	21	6,815	6,83	4	6,87

The tables which follow give Madras average market quotations for tanned hides and tanned skins, which were supplied to the Prices Enquiry Committee by one of the leading firms in the trade. Figures have been included from the year 1905 to 1912, with three earlier years for purposes of comparison. The extremely low prices recorded for tanned cow and buffalo hides in the earlier years are noticeable. In actual sales tanned calf and light hides fetch several pence per lb. more, and heavy weight hides less, than medium weight hides.

TABLE XIV.—*Average prices at Madras of tanned cow and buffalo hides.*

	TANNED COW HIDES.		TANNED BUFFALO HIDES.	
	Fair Quality.	Good Quality.	Fair Quality.	Good Quality.
	Per lb.	Per lb.	Per lb.	Per lb.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
1890	0 5 11	0 6 4	0 4 9	0 5 4
1895	0 7 5	0 8 3	0 6 0	0 7 2
1900	0 6 7	0 7 10	0 5 5	0 6 1
1905	0 10 3	0 11 3	0 7 0	0 7 7
1906	0 10 7	0 11 6	0 8 7	0 9 1
1907	0 10 9	0 11 8	0 8 5	0 9 0
1908	0 10 4	0 11 4	0 7 7	0 8 0
1909	0 9 9	0 10 8	0 7 4	0 7 11
1910	0 11 5	0 12 2	0 8 5	0 9 2
1911	0 11 5	0 12 6	0 8 9	0 9 7
1912	0 12 6	0 13 7	0 9 10	0 10 9

TABLE XV.—*Average prices at Madras of tanned goat and sheep skins.*

	TANNED GOAT SKINS.		TANNED SHEEP SKINS.	
	Fair Quality.	Good Quality.	Fair Quality.	Good Quality.
	Per lb.	Per lb.	Per lb.	Per lb.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
1890	1 2 3	1 3 11	0 12 5	0 13 3
1895	1 4 8	1 6 10	0 15 3	1 1 3
1900	1 3 9	1 6 0	0 14 6	0 15 9
1905	1 2 8	1 4 4	1 1 8	1 5 3
1906	1 4 9	1 6 4	1 4 9	1 6 6
1907	1 3 8	1 5 3	1 2 0	1 3 6
1908	1 3 8	1 5 3	0 15 9	1 2 5
1909	1 4 6	1 6 0	1 0 0	1 2 9
1910	1 3 10	1 6 8	1 1 4	1 3 8
1911	1 4 2	1 6 8	1 2 0	1 4 3
1912	1 4 2	1 6 8	1 4 9	1 6 6

TABLE XVI.—Exports of tanned hides from British India by sea to foreign countries. (See also Tables XII and XXV.)

	QUANTITY IN CWTs.			VALUE IN R ('000)		
	United Kingdom.	Other Countries.	Total.	United Kingdom.	Other Countries.	Total.
1880-81	62,613	258	62,871	35,11	10	35,21
1881-82	83,262	437	83,699	45,15	14	45,29
1882-83	97,831	691	98,522	54,06	31	54,37
1883-84	91,324	1,243	92,567	50,89	54	51,43
1884-85	99,132	3,083	102,215	55,80	1,31	57,11
1885-86	117,286	1,370	118,656	52,54	63	53,17
1886-87	71,417	4,928	76,345	41,36	2,72	44,08
1887-88	106,235	369	106,604	60,40	18	60,58
1888-89	99,991	390	100,381	56,39	19	56,58
1889-90	95,860	813	96,673	53,04	35	53,39
1890-91	98,135	422	98,557	49,03	17	49,20
1891-92	106,428	429	106,857	64,46	27	64,73
1892-93	113,724	509	114,233	63,85	27	64,12
1893-94	71,325	731	72,056	40,32	39	40,71
1894-95	101,750	746	102,496	58,23	44	58,67

1895-96	148,365	4,286	152,651	85,17	2,46	87,63
1896-97	137,868	1,492	139,360	79,08	76	79,84
1897-98	169,864	2,378	172,242	97,30	1,37	98,67
1898-99	110,293	7,768	118,061	63,05	4,28	67,33
1899-1900	138,155	3,152	141,307	83,47	1,91	85,38
1900-01	244,084	10,671	254,755	1,41,15	5,65	1,46,80
1901-02	131,129	3,120	134,249	74,97	1,73	76,70
1902-03	103,665	4,214	107,879	60,27	2,58	62,85
1903-04	96,784	5,841	102,625	57,99	3,47	61,46
1904-05	113,750	9,640	123,390	75,73	6,79	82,52
1905-06	189,203	12,779	201,982	1,45,35	9,45	1,54,80
1906-07	202,112	17,743	219,855	1,59,88	13,08	1,72,96
1907-08	126,132	5,400	131,532	1,00,84	4,68	1,05,52
1908-09	166,414	4,745	171,159	1,36,02	3,61	1,39,63
1909-10	170,345	8,971	179,316	1,37,63	6,74	1,44,37
1910-11	147,696	3,633	151,329	1,24,41	2,99	1,27,40
1911-12	172,881	3,478	176,359	1,45,02	3,28	1,48,30
1912-13	229,075	4,188	233,263	2,00,72	3,77	2,04,49
1913-14	169,687	4,341	174,028	1,54,64	4,15	1,58,79

CHAPTER V.

FINISHED LEATHER AND LEATHER MANUFACTURES BEFORE THE WAR.

Apart from the export trade in East India tanned kips and tanned skins, which may be classed as partly manufactured articles, India exports very little leather before the war, but is on the other hand an importer of considerable quantities of leather goods, principally from the United Kingdom. The export and import figures from 1903-04 to 1913-14 are given on pages 28 and 29.

It will be apparent from these tables that the exports of leather from India are comparatively insignificant. They consist mostly of exports of boots and shoes and unwrought leather to the Straits Settlements, Mauritius, Ceylon and other neighbouring Eastern countries. The imports on the other hand, especially of European boots and shoes and leather belting for machinery, are important. This latter item was only recorded in the trade returns under the heading "Leather" since 1912-13. Prior to that year it was included in the general heading "Machinery and Mill-work," so that separate figures for the earlier years cannot be given. Boots and shoes of materials other than leather are included in the trade returns in the general heading "boots and shoes" up to the year 1911-12. The value of boots and shoes of materials other than leather was in 1912-13 Rs. 7,43,000 and in 1913-14 Rs. 10,60,000. Further details will be found later on page 62 of this Review.

In the aggregate a very large quantity of leather is tanned in India by village chamars and in small village tanneries by more or less primitive methods for local consumption. Reference may be made to the provincial monographs mentioned above on page 5. The most important articles locally manufactured are—

1. Boots, shoes and sandals.
2. Leather buckets for wells.
3. Country saddles and harness, cattle gear, straps, whips, etc.

TABLE XVIII.—Exports of leather and leather manufactures from British India by sea to foreign countries
(See also Table XXXI.)

	VALUE IN RUPEES ('000).				
	Unwrought.	Boots and shoes.	Saddley and harness.	Other sorts.	Total.
1903-04	90	6,14	81	1,28	9,13
1904-05	72	4,70	38	1,23	7,03
1905-06	2,64	4,89	35	1,09	8,97
1906-07	1,98	4,68	25	40	7,31
1907-08	1,53	5,57	27	43	7,80
1908-09	92	4,56	21	19	5,88
1909-10	1,03	3,48	19	21	4,91
1910-11	1,16	3,40	82	29	5,67
1911-12	1,23	2,29	21	99	4,72
1912-13	1,45	1,25	24	43	3,37
1913-14	1,87	87	17	41	3,32

TABLE XIX.—Imports of leather and leather manufactures into British India by sea from foreign countries.
(See also Table XXXII.)

	VALUE IN RUPEES ('000).							Total.
	Government stores.	Boots and shoes.*	Belting for machinery.	Hides and skins, tanned.	Saddlery and harness.	Unwrought.	Other sorts.	
1903-04	1,35	27,93	..	8,91	5,80	3,81	16,58	64,38
1904-05	1,34	34,59	..	9,39	5,82	3,72	15,68	70,54
1905-06	43	34,45	..	10,38	6,95	4,25	19,41	75,87
1906-07	47	29,08	..	11,42	5,27	5,04	22,28	73,56
1907-08	26	38,05	..	8,08	6,01	8,33	24,00	84,73
1908-09	21	38,96	..	9,27	5,78	7,48	23,06	84,76
1909-10	57	37,31	..	10,43	5,92	5,62	21,68	81,53
1910-11	1,01	45,71	..	11,06	5,87	5,82	25,72	95,19
1911-12	1,02	54,99	..	13,36	6,52	8,48	26,70	1,11,07
1912-13	2,04	58,95	20,71	13,93	5,31	7,94	15,64	1,24,52
1913-14	1,89	68,66	25,13	15,37	5,00	5,77	13,85	1,35,67

* Boots and shoes of materials other than leather are included in these figures up to 1911-12, as they were not separately distinguished in the trade returns.

4. Miscellaneous articles such as pakháls (i.e., water bags carried on buffalos), ginning rollers, oil-bottles, huqqas, bellows, etc., and in Burma large numbers of leather drums manufactured from raw hides.

Boots, shoes and sandals locally manufactured are of two classes, (a) boots and shoes of European style and pattern which have become increasingly popular, especially in the towns, and which compete with the cheaper kinds of imported foot wear, and (b) shoes and sandals of Indian pattern. Indian shoes may be divided into two main classes, the heelless shoe, of which the red Morocco Brahmani *juta* is a prominent example, and second a stronger type of shoe with heels, of which an example is the *mundah* shoe. A great many local varieties are distinguishable such as the Gulgabi, Punjabi, Multani, Marwari, etc. These are fully dealt with in the various provincial monographs. Captain Guthrie, after an enquiry conducted in Bombay in 1910, writes—"In Bombay City amongst those who do wear any shoes, one-third wear European styles, one-third sandals, and one-third shoes of native patterns, of which half are of the heelless type and the remainder Gulgabi, Punjabi, Mundah, etc. The red Morocco Brahmani *juta* and sandals are generally worn throughout the Central and Southern divisions. In the Northern division and Sind shoes of the Gulgabi and similar types are much more common."

Of the other articles mentioned in the foregoing list, leather buckets for wells absorb in the aggregate an enormous quantity of leather, considering that these buckets, which have a life of about six months, are used in millions of wells throughout the country. There is, however, a growing movement to replace them by iron buckets, and experiments are being made also with water-bags made from various kinds of vegetable fibres.

In addition to this village tanning we have to record in the pre-war period the establishment of an important leather industry at Cawnpore.

This originated with the establishment of the Government Harness and Saddlery Factory at Cawnpore in 1867, followed in 1880 by Messrs. Cooper Allen & Co., who became the principal suppliers of boots to the British Army in India, the Indian Army and many Government Departments. Their activities however have by no means been confined to Government orders. Other tanneries which followed Messrs. Cooper Allen were the

North-West Tannery (now absorbed by Messrs. Cooper Allen), the Wense Tannery, which failed, Messrs. Shewan & Co., the Cawnpore Tannery and the United Provinces Tannery, all of which are capable of producing leather of high class. Cawnpore is particularly suited to be the centre of a great leather industry. It is in the middle of the best hide producing area in India, has excellent railway communications and can obtain large supplies of Babul bark in the vicinity, this being the tanning material most largely used by Cawnpore tanneries. The Babul bark supplies in the immediate neighbourhood of Cawnpore have now been practically worked out, but plentiful supplies exist a little further afield and the cost of this bark is still relatively low and much cheaper than the Turwad of Madras. We have to note also during the pre-war period the establishment of Sir Adamjee Peerbhoy and Sons' tannery and boot manufactory at Sion near Bombay, and a few other tanneries at Calcutta and elsewhere. The establishment of several new and large tanneries at Calcutta under the management of leading Calcutta firms is a later development due to the war.

We can also record the beginning before the war of a chrome tanning industry in India, of which the Madras Government with the assistance of Mr. Chatterton may be said to have been the pioneer, though full recognition should be accorded to the energy and enterprise of Mr. Chambers. This new industry is so important and so full of promise for the future that it is worth while repeating here the history of its origin as described in Mr. Couchman's Handbook of Commercial Information, Madras, 1916.

"The earliest chrome tanning experiments in Madras were made about 1902 by the German firm Messrs. Carl Simon Soehne. It was stated that the results were not encouraging, and probably it was on account of the unfavourable reports made by this firm that the Madras Chamber of Commerce was led about this time to express an adverse opinion as to the possibilities of chrome tanning in Southern India.

"Later on a Parsi from Bombay by the name of Talhati endeavoured to arouse the interest of Madras tanners by lectures on chrome tanning and by demonstrations at a small tannery in Thangal, a suburb of Madras. He however failed to raise the necessary interest and capital to continue his efforts. About the same time (1902-03) Mr. Chatterton turned his attention to the possibili-

ties of chrome tanning, and also about the same time Mr. Chambers, who had for several years previous been connected with the leather trade in Madras, was endeavouring to obtain Government support and to interest leading Madras mercantile firms in the possibilities of the chrome tanning industry in Madras.

“Mr. Chatterton’s first experiments were made at the Madras School of Arts, where he demonstrated that he could produce chrome tanned leather suitable for the making of agricultural water buckets of a quality and durability much exceeding those of ordinary bark tanned leather. Subsequently operations were transferred to a tannery at Sembium near Madras. Mr. Chambers’ first efforts in chrome tanning were made on his own account at Pallavaram early in 1904 and subsequently were continued on a larger scale at Tondiarpet, another suburb of Madras; at the same time the finishing of bark tanned goat skins for Moroccos and of hides for carriage upholstery was added. Government ultimately decided to leave the development of the industry to private enterprise and closed down the Government Tannery and substituted a Leather Trades School. The machinery and effects of the Government Tannery were sold to the Indian State of Rewa. Subsequently Mr. Thiruvengada Achari, who was associated with Mr. Chatterton’s efforts from the start, succeeded in arousing the interest of the Mysore Government and of a few capitalists and as a consequence the Mysore Tannery, Limited, was floated with a capital of Rs. 1,70,000 and commenced operations near Bangalore; their early efforts, like those of the Chrome Leather Co., Madras, owned by Mr. Chambers, were however handicapped by difficulties as regards labour and markets, but in both cases considerable and steady progress has been made. The Mysore Tannery is at present centralising its efforts to build up an export trade in chrome tanned black box sides, a highly popular and serviceable leather for boots, and Mr. Thiruvengada Achari has also just recently on behalf of local financiers established a chrome tannery in Berhampur, Bengal, and there also chrome tanned black box sides are being produced and exported *via* Calcutta.”

“The business of the Chrome Leather Co., Madras, which now finds use for a capital of about 9 lakhs, has developed considerably during the past three years. Their new tannery and factory is situated at Pallavaram where they find employment for about 1,000 men. So far these chrome leather productions, which comprise both sole and upper leather, also belting, find a ready market in India

and the East. The Company has also developed a considerable trade in bark tanned sole leather of a superior quality. Its efforts at present are largely devoted to the production of all classes of manufactured leather goods and it is supplying a large quantity of footwear and accoutrements to the Indian Government. Considerable extensions are at-present being made to the works with a view to the export on a large scale of chrome tanned upper and sole leathers."

PART II.

The War Period.

CHAPTER VI.

SUMMARY OF THE RESULTS OF THE WAR ON THE TRADE.

The course of the Indian hides, skins and leather trade during the war has been to a great extent artificial. As in all countries, there has unavoidably been a large measure of Government control due to the necessity of securing the maximum quantity of leather suitable for war purposes. In this it will be seen that India has been able to make an important contribution towards the war. It follows however that certain lines of the trade have been artificially stimulated while others have suffered from restrictions. In particular there has been a great expansion in the tanning of hides in Madras and Bombay for export to the War Office, and a great increase in the Government orders for boots and leather equipment. Local leather manufacturers have also been able to take advantage of the reduced imports of certain classes of leather goods from England. On the other hand, there has been a reduction in the exports of raw hides; and in the tanned skins trade, after a period of phenomenal prosperity in the first three years of the war, there followed a period of unavoidable restriction, due to the necessity of turning all energies to the production of tanned hides for the War Office.

The year 1916-17 was the year of maximum export and the exports of that year far exceeded in value those of 1913-14 which were the highest for the pre-war period. In 1913-14 there was a total export of all classes of hides and skins of 1,906,931 cwts. valued at Rs. 15,91,22,000. In 1916-17 there was an export of 1,952,068 cwts. valued at Rs. 23,86,56,000, as detailed below:—

TABLE XX.—Comparison of the years 1913-14 and 1916-17.

	1913-14		1916-17	
	Quantity in cwts.	Value in Rs. ('000.)	Quantity in cwts.	Value in Rs. ('000.)
Raw hides	1,115,747	8,29,60	894,028	7,49,20
Tanned hides	174,028	1,58,79	323,676	4,49,33
Raw skins	486,563	3,39,04	568,313	6,91,63
Tanned skins	130,593	2,63,79	166,051	4,96,40
Total	1,906,931	15,91,22	1,952,068	23,86,56

CHAPTER VII.

THE RAW HIDES TRADE DURING THE WAR.

The statistics of exports of the different classes of raw hides from British India during the first four years of the war are given in the following table on page 39.

It will be seen that there has been a great reduction in exports of both raw cow hides and buffalo hides. There was no direct Government control of buffalo hides, and the reduction in exports is attributable firstly, to the absorption of much greater quantities of buffalo leather in India for soles of Army boots and equipment of all sorts, and secondly, to the irregularity of the American market which is the largest buyer of Indian buffalo hides. It will be noticed that in 1916-17 the United States took a record quantity of buffalo hides, 215,718 cwts., whereas in the next year she took only 54,823 cwts., less than half the quantity she was accustomed to take before the war.

Buffalo hide prices declined sharply on the outbreak of the war and remained at about the 1908-09 level for several months. The subsequent average has been higher—with occasional sharp fluctuations up and down—but it has not reached the average price prevailing immediately before the war.

Raw cow-hide exports have been subject to more direct Government control. In the first years of the war the shutting off of the German and Austrian markets was quickly compensated for by increased purchases by Italy and the United States. In the year 1915-16 Italy, which was then in the stage of preparing for war with Germany, took 358,718 cwts. of Indian hides, an amount nearly equal to the largest pre-war export to Germany. The United Kingdom also began to take larger quantities. With the Government control of hide tanning in Madras and Bombay, which was inaugurated in August 1916, the control of raw hide exports became closer. It was confined at first to partial restrictions on the export of hides of army

weight, but in June 1917 the Indian Munitions Board undertook direct purchase of raw hides for the British War Office and for the Italian Government, and as the balance of hides of army weights and selections was required for Madras and Bombay tanners, export on private account except of light weight hides and certain classes of inferior hides practically ceased. The fact that much larger quantities of hides were tanned in India accounts to a great extent for the diminution in exports of raw cow hides, but difficulty in obtaining freight and the high cost of it when obtainable also militated against export of the lowest qualities of hides. In normal times a freight rate of about $\frac{1}{2}d.$ a lb. was small in comparison with the value of the raw hide, but when that rate became $4d.$ or $5d.$ a lb. it obviously made impossible the export of the lower grades. The disappearance of an export market for the lowest grade hides was one of the inevitable consequences of the war.

The outbreak of war with Germany naturally led to the disappearance of the majority of the exporting firms in Calcutta, those of German nationality being wound up and others going into voluntary liquidation, or disposing of their business to British or allied firms. The Government Committee for hide purchases in Calcutta was formed originally of five firms, three British and two Indian, to which three other British firms, new to the trade, were added later. A Government Committee was also formed at Karachi where none of the exporting firms were of enemy nationality, though a large proportion of the pre-war trade, as in Calcutta, had been with Germany and Austria. It may be expected that after the war export of Indian raw hides to the United Kingdom will continue on a large scale, as it is understood that British tanners are making preparations to deal with increased quantities of Indian hides. It is also certain that there will be a strong demand from Italy and the United States, and sample consignments have attracted attention in Canada, South Africa, and Australia. Spain and France will also be likely to require Indian hides. It is certain therefore that India will not in future be dependent on Germany and Austria for her markets. Moreover India herself is likely to require a much larger proportion of her hides for Indian tanners. This question is particularly important in connection with the Madras and Bombay trade in East India Kips. One of the most striking developments of this trade during the war has been the increased quantities of the best class of Northern Indian hides which have been tanned in Madras

TABLE XXI.—Exports of raw cow hides, buffalo hides and calf skins from British India by sea to foreign countries from 1914-15 to 1917-18. (See also Tables III and VIII.)

	QUANTITY IN CWTs.							VALUE IN RS. ('000)								
	United King- dom..	Italy.	United States.	France.	Austria	Ger- many.	Other coun- tries.	Total.	United King- dom.	Italy.	United States.	France.	Austria.	Ger- many.	Other coun- tries.	Total.
Buffalo Hides, raw—																
1914-15 .	52,062	1,322	107,074	1,368	20,700	7,744	21,376	211,745	28,39	95	75,52	81	16,47	5,49	10,67	1,38,30
1915-16 .	41,711	10,251	108,405	55	..	..	2,375	162,887	19,96	6,18	66,26	1	..	..	97	93,28
1916-17 .	37,426	2,233	215,718	230	..	..	5,492	261,099	23,20	1,87	1,73,08	12	..	..	4,47	2,02,74
1917-18 .	28,574	1,075	54,823	31	..	..	397	84,900	22,88	71	39,96	2	..	..	19	63,76
Cow Hides, raw—																
1914-15 .	77,023	66,211	73,884	6,867	38,865	137,655	79,108	480,513	55,43	53,44	46,17	4,25	32,96	1,18,69	60,69	3,71,63
1915-16 .	56,208	358,718	101,657	21,679	..	..	60,761	689,113	44,50	3,12,40	1,47,91	10,30	..	..	16,39	5,61,59
1916-17	106,090	163,721	208,604	37,308	..	..	65,913	581,645	91,28	1,13,20	1,80,08	25,58	..	..	57,25	5,00,39
1917-18 .	148,155	152,540	10,743	1,246	..	..	4,895	317,588	1,05,55	1,13,78	8,09	98	..	..	3,62	2,32,02
Calf Skins, raw—																
1914-15 .	2,044	4,666	8,092	384	470	1,083	4,410	21,158	1,53	3,24	5,16	26	31	69	3,68	14,87
1915-16	1,157	14,391	12,813	190	..	..	1,210	29,761	1,01	10,52	10,93	16	..	..	99	23,61
1916-17 .	1,264	6,917	36,845	24	..	..	5,883	50,933	1,03	6,16	32,59	2	..	..	5,56	45,96
1917-18 .	118	2,607	12,557	..	..	..	133	15,415	10	2,03	10,53	..	..	..	12	12,78

and Bombay. Even before the war these tanners were not entirely dependent on local supplies, but they secured from Northern India for the most part only inferior hides, the better classes being attracted by the exporters of raw hides. The movement of raw hides from Northern India during the war can be seen from the statistics of imports by rail of raw hides into the Madras and Bombay Presidencies.

TABLE XXII.—Imports by rail of raw hides from Northern India.

	Average of 5 years 1909-10 to 1913-14.	1915-16.	1916-17.	1917-18.
	cwts.	cwts.	cwts.	cwts.
Into Madras Presidency	14,000	30,000	66,000	112,000
Into Bombay Presidency	12,000	38,000	54,000	94,000

This movement which has resulted in a much larger proportion than formerly of the best Indian hides being tanned in India rather than exported in the raw state has been of advantage to the Indian tanning industry, and it is one of the important post-war problems connected with this trade to secure to the Indian tanner his position in this respect *vis-à-vis* the raw hide exporter. It may be added that an increased trade in raw hides has also developed during the war between Rangoon and Madras. Rangoon hides, though often badly butcher-cut, are of good quality and substance and are eminently suitable for the trade in East India Kips.

The prices of raw cow-hides during the war have been to a great extent controlled by Government's operations both as direct purchasers for export and as purchasers of East India tanned Kips at fixed f.o.b. prices. Prices of raw cow-hides during the war. The prevailing level of raw cow-hide prices has been somewhat below the very high rate prevailing immediately before the war and is illustrated by the following table which is a continuation of that shown on page 12.

TABLE XXIII.—*Prices of raw cow-hides during the years 1915 to 1918 in Rs. per 20 lbs. (See Table VII.)*

	RAW COW-HIDES ARSENICATED.				RAW COW-HIDES DRY-SALTED.			
	Agras 9 to 10 lbs.	North- Westerns 9 to 10 lbs.	Dur- bungahs 8 to 9 lbs.	Patnas 9 to 10 lbs.	Daccas 9 to 11 lbs.	Daissies 8 to 10 lbs.		
January—	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
1915 . . .	16 0 0	14 0 0	14 0 0	9 8 0	12 4 0	11 4 0		
1916 . . .	15 12 0	14 0 0	12 12 0	9 4 0	10 4 0	8 4 0		
1917 . . .	18 8 0	15 0 0	12 0 0	10 8 0	9 4 0	8 4 0		
1918 . . .	18 0 0	14 8 0	12 0 0	9 0 0	8 12 0	7 12 0		

The Indian hides trade suffers greatly from the careless and inefficient manner in which the majority of the raw hides are collected and preserved. A specially undesirable feature of the trade is the deliberate overloading of dry-salted hides with dirt and cement and other substances on the flesh side in order artificially to increase the weight. A good deal of improvement had been effected before the war by the combination of the Calcutta exporting firms, but the position became worse after the war when there was a great deal of indiscriminate buying without regard to the cure. When Government became a purchaser they did their best to effect an improvement in this matter, but with little result so that they were eventually driven to make the announcement that they would refuse to purchase any dry-salted hides which were not properly cured. The "real Meherpore" cure was taken as the standard. This should in time lead to a real improvement in the cure, but immediate improvement was prevented by the continuance of indiscriminate purchases by Indian tanners. In the end the Government Committee has had to undertake the entire responsibility of purchases for Madras tanners in the Calcutta market.

Two other ways in which much valuable leather is lost to India are by the faulty methods of flaying and the improper flaying of hides and branding of cattle. The Indian Munitions Board has devoted much attention to attempts to improve matters in these respects. The attention of Local Governments and the public was early directed to these questions in a Press Notice, and a pamphlet in simple language was subsequently

prepared by the Director of Industries in Bengal, which gave instructions as to the proper method of flaying and of preparing wet-salted, dry-salted and air-dried hides. This pamphlet has been widely circulated through Local Governments to district officers and local bodies and to the Civil Veterinary Departments and has been translated into a number of vernaculars. Direct action has also been taken in certain places to give instruction to chamars in the proper flaying and preservation of hides, and in several slaughter-houses, *e.g.*, at Rangoon, local rules have been passed by which the flaying of cattle is now properly supervised. As an instance of what can be effected by proper management reference may be made to the Bandra slaughter-house at Bombay where control has been exercised directly by the Deputy Controller, Hides, Bombay. By obtaining more time for the butchers to do their work properly and by paying a small premium for all well-flayed hides, the proportion of hides from this slaughter-house rendered unsuitable for Army work by faulty flaying has been reduced from about 60 per cent. to less than 5 per cent. The Esociet Company of Maihar in Central India also reports excellent results in the improved condition of hides collected in the Indian States with which the company is associated. The improvement has been effected by securing to the chamars very high prices for well preserved hides and very low prices for faultily preserved hides. Improvement in a matter of this kind in a country such as India is necessarily slow, but a beginning has at any rate been made.

The branding of cattle is a more difficult matter to deal with as it is bound up in some areas with the religious ideas and prejudices of the people. In some provinces such as Burma the practice is hardly known; in others it is very common and in Ceylon it is said to be almost universal. Nearly all the Ceylon hides tendered to Government in Madras have been ruined by branding. Where branding is necessary for purposes of identification, a small brand on the forehead or on the shank or even on the horn or hoof should be sufficient.

CHAPTER VIII.

THE RAW SKINS TRADE DURING THE WAR.

Export statistics of
raw skins during the
war.

The exports of raw goat and sheep skins from British India during the first four years of the war are shown on page 44.

On the whole the war has had less effect on this branch of the trade than on any other. No direct purchases of goat or sheep skins were made by Government and the trade was mainly dependent, as before the war, on the American market. This market was at times erratic, but during the first four years of the war the quantity of exports was nearly up to the pre-war average. In the summer of 1918 the Government of the United States imposed a total prohibition on imports of skins, raw and tanned, and hides, except under special licenses to cover existing contracts. This was imposed as part of their policy to reserve freight for articles of war importance, and the prohibition is expected only to be temporary.

Prices of raw skins declined sharply on the outbreak of war being Rs. 20 to 30 per 100 pieces on the average below pre-war rates. There was a rapid rise in 1916, and during 1916 and 1917 prices were at least equal and at times considerably above the best pre-war prices.

TABLE XXIV.—Exports of raw goat and sheep skins from British India by sea to foreign countries from 1914-15 to 1917-18. (See also Table X.)

	QUANTITY IN CWTs.						VALUE IN RS. ('000.)					
	United Kingdom.	United States.	Italy.	France.	Other Countries.	Total.	United Kingdom.	United States.	Italy.	France.	Other Countries.	Total.
Goat skins, raw—												
1914-15	39,305	300,076	..	8,667	33,412	382,060	19,68	1,80,22	..	7,76	26,49	2,34,15
1915-16	33,421	353,097	..	7,573	4,037	399,951	18,66	2,45,18	..	6,48	4,86	2,75,48
1916-17	41,646	452,151	6	21,893	7,199	522,895	42,55	5,55,98	1	32,78	11,01	6,42,36
1917-18	49,551	329,238	2	6,836	22,907	408,537	53,63	3,58,12	..	11,45	31,63	4,54,83
Sheep skins, raw—												
1914-15	326	24,682	120	18	1,140	26,295	42	18,18	9	1	1,15	19,85
1915-16	340	31,404	141	..	632	32,517	22	22,10	10	..	74	23,16
1916-17	60	43,884	54	..	1,310	45,314	3	47,51	3	..	1,18	48,75
1917-18	3,302	29,944	..	109	5,140	38,594	4,34	30,75	..	17	3,52	38,78

CHAPTER IX.

THE TANNED HIDES TRADE DURING THE WAR.

As already indicated, the increase in the exports of tanned hides—
 Development of the East India Kips—has been one of the most
 trade in East India striking features of the Indian leather trade
 Kips during the war. during the war. The value of the Madras
 and Bombay turwad-tanned hides as material for upper leather of
 army boots was not, it is true, fully realised during the first year
 of the war, but subsequently every effort was made to increase and
 regulate the supply. From August 1916, the Indian Government,
 at the request of the War Office, assumed complete control of the
 trade and has purchased in India the whole of the available supply
 for export direct to the War Office. On the creation of the Indian
 Munitions Board, the control of the arrangements for purchase of
 East India Kips was taken over by the Board. The requirements
 of army upper leather for the year 1917 were estimated at 80 million
 feet as a minimum. East India Kips give an average of 24 feet
 when dressed into “sides” but less when dressed into “butts.”
 Taking an all-round figure of 18 feet, 1,500,000 kips, which was the
 average annual production suitable for upper leather in the years
 preceding the war, would give 27,000,000 feet of upper leather.
 The actual production of East India Kips has more than doubled
 since the period of Government control, and it has been estimated
 that at least three-fifths of the upper leather used in the United
 Kingdom in the manufacture of boots for the British and Allied
 armies is supplied from them. In addition a large proportion
 of the kips found unsuitable for army work have been used in
 production of the war-time standard boot in England, and not less
 than 30,000 kips monthly have been supplied by Bombay tanneries
 to Cawnpore for the manufacture of army boots in India.

The war-time exports of tanned cow-hides and buffalo
 hides, both of which were included in the
 Statistics of export and outturn of East Government purchase scheme, are given
 India Kips. on page 46.

TABLE XXV.—Exports of tanned cow hides and buffalo hides from British India by sea to foreign countries from 1914-15 to 1917-18. (See also Table XII and XVI.)

	QUANTITY IN CWTs.			VALUE IN RUPEES ('000.)		
	United Kingdom.	Other Countries.	Total.	United Kingdom.	Other Countries.	Total.
Buffalo hides, tanned—						
1914-15	24,371	890	25,261	22,80	83	23,63
1915-16	23,894	340	24,234	21,43	34	21,77
1916-17	31,910	436	32,346	35,09	48	36,17
1917-18	18,073	483	18,556	18,38	57	18,95
Cow hides, tanned—						
1914-15	189,551	2,014	191,565	2,15,25	1,82	2,17,07
1915-16	246,366	1,014	247,380	2,82,89	90	2,83,89
1916-17	286,109	905	287,014	4,03,63	88	4,04,51
1917-18	346,044	543	346,587	4,70,84	64	4,71,48

Thus in the year 1917-18 we have recorded exports of 365,143 cwts. of tanned cow and buffalo hides, valued at Rs. 4,90,43,379.. The actual outturn for 1917-18 was considerably in excess of the recorded figures of shipments inasmuch as Government held in stock at Madras awaiting shipment on the 31st March 1918 about 65,000 cwts. of tanned hides costing approximately Rs. one crore. The increase in the value of the shipments of tanned hides is even greater proportionately than the increase in quantity. Taking the year 1911-12 as a basis and giving to it the index number 100, we get the following results:—

TABLE XXVI.—*Index numbers illustrating shipments of tanned hides.*

	Quantity shipped.	Value.	Average Rate per lb.
			<i>Rs. a. p.</i>
1911-12	100	100	0 12 0
1912-13	132	138	0 12 2
1913-14	99	107	0 13 0
1914-15	117	163	0 15 10
1915-16	154	206	1 0 0
1916-17	184	303	1 3 10
1917-18	208	331	1 3 3

It will be seen that while the quantity shipped has more than doubled, the value has more than trebled.

The figures just quoted give an indication of the increase in tanned hide prices during the war. It has to be remembered however that not only have the tanners been dealing with a better and more expensive class of raw hide but the cost of tanning has greatly increased, mainly because of the higher prices of tanning materials. This is an important matter which will be referred to later on.

Prices obtained for tanned hides prior to the Government scheme of control are not easy to give, since the hides were mostly sold in London on firms' special standards. In May 1914 Coasts-light were about 19½d. per lb. c.i.f. London. In 1916 about 23¾d. per lb. Heavies on the same dates were 18d. and 22½d. per lb. Freight in 1916 was fully 1d. per lb. above that in 1914.

Under the Government scheme cow hides were classed as army selections and non-army selections. Army selections consisted of seconds, thirds and 'superior' fourths in the following ranges of weights, 6 to 14 lbs., 14 to 18 lbs., 18 to 25 lbs. Light weights below 6 lbs., 'inferior' fourths, fifths and rejections comprised the non-army selections. The price basis, as revised in May 1917, was from Re. 1-6-9 per lb. to Re. 1-3-3 per lb. f.o.b. for the ordinary run of parcels containing seconds, thirds and 'superior' fourths in proportions of 25 : 50 : 25. The price of fifths varied from Re. 0-13-6 to Re. 0-10-9 : for rejections 9 annas per lb. was offered though at this price no rejections were tendered to Government since it paid tanners better to sell them locally. The average all-round price may be taken as in the neighbourhood of Re. 1-3-3 per lb., which is confirmed by the export figures quoted above. For tanned buffalo hides, prices of army selection, "Primes," were 15 annas per lb. for hides from 5 to 15 lbs. in weight, and 13 annas per lb. for weights from 15 to 20 lb. "Bests" were priced at 13 annas and 11 annas per lb. respectively for the same ranges of weights. Prices of non-army selections were 4 annas per lb. lower.

The complete scale of Government prices at Madras for tanned cow hides is recorded in the table on page 49. The Government prices for tanned buffalo hides are given below.

TABLE XXVII.—*Tanned buffalo hides.*

Prices per lb. f.o.b. Madras.

	Army selections.		Non-Army selections.		Smalls Assort.	Calf Assort.
	5/15	15/20	5/15	15/20	75,25	75,25
	Annas.	Annas.	Annas.	Annas.	Annas.	Annas.
Prime . .	15	13	11	9	14	14
Best . .	13	11	9	7	12	12

At Madras the fourteen leading shipping firms selected and baled the hides and tendered them to Government who examined representative samples of each consignment before making payment. Payments were made on rupee prices by bills drawn on

TABLE XXVIII.—*Tanned cow hides.*

Prices per lb. f.o.b. Madras.

Classification.	3/14 Lights.				14/18 Heavies.				18/25 Extra Heavies.				Fitches.	Cow Calf (Assrt.)		REMARKS.
	II.	III.	IV.		II.	III.	IV.		II.	III.	IV.		3/14	25/50/25		
Prime . . .	Rs. A. P. 1 10 9	Rs. A. P. 1 6 9	Rs. A. P. 1 1 9		Rs. A. P. 1 7 9	Rs. A. P. 1 3 9	Rs. A. P. 0 14 9		Rs. A. P. 1 2 9	Rs. A. P. 0 14 9	Rs. A. P. 0 10 9		Rs. A. P. 0 13 6	Rs. A. P. 1 6 0		
Best . . .	1 0 3	1 5 3	1 0 3		1 6 3	1 2 3	0 13 3		(a) 1 2 0 (b) 1 1 9	0 14 0 0 13 9	0 10 0 0 9 9		0 12 3	1 5 0		(a) Prime Bangalores. (b) Other kinds.
Good . . .	1 8 3	1 4 3	0 15 3		1 5 3	1 1 3	0 12 3		1 1 3	0 13 3	0 9 3		0 12 0	1 4 0		
Ordinary . . .	1 7 3	1 3 3	0 14 3		1 4 3	1 0 3	0 11 3		1 0 3	0 12 3	0 8 3		0 10 9	1 2 0		
Rejections . . .	0 0 0															

Price for the 'run' selection 25 IIs, 50 IIIs, 25 IVs is the same as for IIIs.

the War Office, Government accepting the loss on exchange and making all freight arrangements. At Bombay, where shipments had always been on consignment and the shippers had no technical knowledge of the selections, Government bought direct from the tanners and assorted the hides themselves for shipment. An all-round price was paid to tanners at Bombay for army selections of Re. 1-4-0 per lb. Non-army selections were classed as first rejections at Re. 1-0-0 per lb. and second rejections at 0-12-0 per lb.

One of the main objects of the above scale of prices was to increase the quantity of army selection leather. For this reason a relatively low scale of prices was fixed for non-army selections. Shipment on private account of non-army selections was prohibited, so as to prevent tanners from being induced to tan inferior hides by the higher prices which could have been obtained at home for the lower classes. The War Office was able to utilize the greater part of the non-army selections in the production of war-time standard boots, but a certain proportion was resold in England to the civil trade. The attempt to increase the proportion of army selection leather was successful at Madras, though much less so at Bombay. At Madras the proportion of army selections rose from slightly over 50 per cent. to 65 per cent. and for a considerable period to 70 per cent. The following figures, which were taken over a three months' period, are fairly representative of the proportions in which hides were tendered—

	Per cent.
Seconds	24.0
Thirds	30.0
'Superior' Fourths	3.5
Extra heavies and army selection Buffs . . . . .	.5
"Lace" hides	7.0
TOTAL ARMY SELECTION	65.0
 'Inferior' Fourths	 17.5
Fifths	3.5
Lights II ^s , III ^s and IV ^s	11.5
Ordinary	1.0
Buff calf and smalls . . . . .	.5
Cow calf	1.0
TOTAL NON-ARMY SELECTION	35.0
	100.0

In May 1917 Government requisitioned a tannery at Bombay and worked it under the direct management of the Deputy Controller, Hides. This tannery used for the most part hides from the Bandra slaughter-house and the following results of a year's working may be of interest.

Number of hides tanned—55,779.

	Per cent.
Army selection hides	90.4
Lights and calf	6.9
First rejections	2.2
Second rejections	0.4
Double rejections	0.1

The total number of rejections was thus only 2.7 per cent. of the whole.

The cost of production worked out at Rs. 1-2-8 per lb. as follows :—

	Rs.	A.	P.	Percentage of total cost.
Hides	0	14	1	75.4
Tanning materials	0	3	2	17.1
Direct labour	0	0	11	4.9
Supervision and other indirect charges	0	0	6	2.6
	1	2	8	100.0

A detailed account of the working of this tannery has been published by the Indian Munitions Board for the information of tanners. The results obtained were due not only to the selection of the raw hides and the special measures taken to improve the flaying of the hides in the Bandra slaughter-house, but also to care and attention at all stages of the liming and tanning processes. Similar results cannot be expected in every tannery since this tannery was in a position to use only the best class of raw material, but the results obtained are an indication of what is possible under the most favourable conditions of working.

An opportunity was afforded by the Government control to deal with the question of adulteration and improper weighting of hides. In the early days of the Government scheme it was found that adulteration of hides by the addition in course of tannage of magnesium salts, sugar and other adulterants was on the increase. One instance came to notice of a parcel of hides being adulterated

to the extent of 29 per cent. with Epsom salts. The leather adulterated in this way was liable to be completely spoilt, or at the best considerable expense was incurred by the adulterants having to be washed out in England. Attempts were made to check this practice by penalising heavily all adulterated hides presented to Government and by refusing altogether badly adulterated hides. Adulteration is not however in all cases easily detected without chemical analysis, and eventually, with the full approval of the commercial community in Madras, the practice of adulterating hides was made a penal offence by an order passed under the Defence of India Rules. To the credit of the Madras tanners it should be stated that in no single case has it been found necessary to proceed against a tanner for non-observance of these orders. In addition to this form of adulteration it used to be a prevailing practice in the case of certain tannages—notably “Bangalores”—to add weight to the hide by the application after tannage of chalk and plaster to the flesh side. The practice—which did not occur in Bombay tannages—although not injurious to the leather in the same way as adulteration, adds nothing to its value but is merely a form of artificial weighting. The chalk and plaster has in all cases to be washed off by the currier in England before the hides can be used. The plastering of the hides also results in cuts on the flesh side being disguised. This practice also was prohibited by an order under the Defence of India Rules. The result has been that several of the so-called distinctive tannages in Madras have become practically indistinguishable from one another and instead of recognizing eight or nine separate tannages it has been possible to classify all Madras tannages into four grades—Prime, Best, Good and Ordinary, each of the first three being subdivided into two classes according to their growth and spread. “Ordinary” hides were thin hides without sufficient substance for army work and were classed as non-army selection. There is evidence that this simplified classification and the prohibition of artificial weighting of hides has been appreciated by the Home trade. The question of adopting permanent measures to prevent adulteration after the war has been taken up by the Controller of Munitions at Madras and the views of the commercial community are understood to be generally in favour of some action being taken though agreement has not been arrived at regarding details. It is not too much to hope that the improvements effected as a war measure may not be entirely lost.

in time of peace, as they should enhance the reputation of East India Kips in the Home markets.

The increased cost of tanning during the war was due principally to the higher prices which had to be paid for Tanning Materials. Turwad bark. Since on the average about 3 Importance of Turwad. lbs. of bark are required for each lb. of leather produced, the total quantity needed was enormous, and in order to meet the demand from hide tanners it was found necessary to prohibit skin tanning altogether: at the same time in order to steady prices, Government undertook the complete control of collection and distribution of Turwad bark in the Madras Presidency, and also controlled supplies from Mysore and Hyderabad States which furnish not less than half the requirements of Madras tanners. In Bombay also control of Turwad supplies to tanners was regulated by the Deputy Controller, Hides. Mr. Chatterton, writing in 1905, estimates that the price of Turwad then averaged 15 rupees per candy (500 lbs.). He was also able to record that the supply was apparently enormously in excess of the demand. In the years immediately preceding the war Turwad prices were from Rs. 15 to Rs. 25 per candy. In August 1916 Rs. 40 to Rs. 50 was being paid for the best bark, and a few months later the competition for bark by skin tanners raised prices to Rs. 80 and even more. Prices under the Government control were fixed at Rs. 27-8-0 to Rs. 37-8 per candy. Later on the price of the best bark was raised to Rs. 42-8 and prices for lower qualities reduced to Rs. 20 and even less. Another tanning bark which is regularly used by the Madras tanners in mixture with Turwad is the bark of *Cassia fistula* (*Konai* or *Amaltas*). This is somewhat cheaper than Turwad though it has also greatly increased in price in recent years. At present prices for bark and other materials and labour, the cost of tannage is on the average not less than 4 annas per lb. of leather produced. At the time when Turwad prices were highest Government undertook the experiment of importing a large quantity of Wattle bark from South Africa for use in Madras and Bombay. After some initial difficulties had been surmounted, it was found that with certain precautions a proportion of this bark could be used successfully in mixture with Turwad, and the whole quantity, exceeding 1,000 tons, has been utilized by the tanners working for the War Office. The experiment cost Government about Rs. 15,000, but it was particularly

valuable inasmuch as several kinds of Wattle grow in the Nilgiris and an effort is being made to exploit this source of supply.

In view of the immense demand for Turwad bark, which is certain to continue after the war both for hide and skin tanning,⁵ the Indian Munitions Board has urged all Local Governments, both in the ordinary turwad-growing areas and outside them, to take measures to extend the cultivation of the shrub. Active measures have been taken in Madras and Bombay and also in the Central Provinces, United Provinces, Burma and elsewhere both in forest areas and other lands. It is feared, however, that the unfavourable monsoon conditions in some of these areas have done serious damage to many of the plantations. The experience obtained from the plantations of Turwad at the Forest Research Institute, Dehra Dun, is worth recording. The inferences drawn by Mr. R. E. Marsden, Forest Sylviculturist, from the Dehra Dun experiments are that direct over-head cover is injurious, that light well-drained soil is desirable and that protection from browsing is needed. Weeding is desirable, and but not essential. Frost is highly injurious, but provided enough plants are raised before the cold weather, 40 or 50 per cent. should survive. Irrigation is not needed. Early thinning out of the lines is recommended. The seedlings are highly susceptible to root-rot in land charged with excessive moisture. It is probable that in the future the larger tanneries will find it advantageous to have their own Turwad plantations close to the tanneries, and several of them have already taken steps in this direction.

Much attention has been devoted by the Indian Munitions Board to the discovery and trial on a commercial scale of substitutes for Turwad in making 'half-tan' leather, and the Board has acquired for purposes of research in this and other directions the Factory belonging to the Esociet Company of Maihar in Central India, where experiments with Northern and Central Indian tanstuffs had been conducted for some years previously. The Board also purchased the Allahabad Tannery in order to test, on a commercial scale, results obtained at Maihar and has also conducted experiments in various tanneries at Bombay. The Allahabad tannery is now producing 'crust' leather without Turwad for supply to the Government Harness and Saddlery Factory at Cawnpore for equipment work. The services of an expert Master tanner have been obtained from England to advise Government in regard to research and the

development generally of the tanning industry in India. In part III of this Review an account is given of the results of research at Maihar. Many of these results indicate promising lines of development for the future, but the fact remains as true as ever that there is no single tanning material available in this country which possesses all the qualities of Turwad for production of 'crust' leather. The great merits of Turwad bark are that it is very easy to use and quick in its action; it adds weight and plumpness to the hide and produces a leather which is capable, after further treatment by the currier, of being turned to a great variety of uses. The maintenance therefore of an adequate supply of this tanstuff at cheap rates must remain the foundation of the 'half-tan' industry of Southern India, and it is desirable that it should also be made available for tanners in other parts of the country.

CHAPTER X.

THE TANNED SKINS TRADE DURING THE WAR.

The exports of tanned goat and sheep skins during the first Exports of tanned four years of the war are shown on page skins during the war. 57.

Statistics of "tanned skins, other sorts" (see page-22 above) relate principally to tanned calf skins, which were included in the Government tanned hides purchase scheme.

TABLE XXIX.—Exports of "tanned skins,—other sorts" from British India by sea to foreign countries. (See also Table XIII).

	QUANTITY IN CWTs.			VALUE IN RS. ('000.)		
	United Kingdom	Other countries.	Total.	United Kingdom.	Other countries.	Total.
1914-15 . .	10,114	25	10,139	12,02	3	12,05
1915-16 . .	7,173	31	7,204	8,01	5	8,06
1916-17 . .	12,801	3	12,804	19,88	1	19,89
1917-18 . .	60,95	25	6,120	8,16	14	8,30

The figures given in the Table on page 57 show that the first three years of the war were a period of steadily increasing exports and rapidly increasing prices for tanned goat and sheep skins. The position became accentuated when the control of leather in England and other belligerent countries practically forced the greater part of the tanneries in those countries to produce war leathers. In consequence there was a leather famine in the civil trade and any Indian tanned skins that were able to reach those markets realised extraordinary prices. The result of this was to stimulate the tanning of skins in India in preference to hides and to cause such competition for bark supplies that prices for bark were forced up to levels at which the hide

TABLE XXX.—Exports of tanned goat and sheep skins from British India by sea to foreign countries in the years 1914-15 to 1917-18. (See also Table XVII.)

	QUANTITY IN OUNCS.						VALUE IN RS. ('000.)					
	United Kingdom.	United States.	Straits Settlements.	Japan.	Other Countries.	Total.	United Kingdom.	United State.	Straits Settlements.	Japan.	Other Countries.	Total.
Goat skins, tanned—												
1914-15	53,404	6,913	..	188	783	61,288	1,16,11	14,00	..	37	1,06	1,32,44
1915-16	44,849	25,082	..	37	205	70,773	95,23	52,41	..	8	33	1,48,05
1916-17	51,621	30,073	..	109	652	85,455	1,77,26	80,87	..	31	1,81	2,00,05
1917-18	8,880	1,747	..	50	23	13,709	40,02	18,65	..	17	9	64,93
Sheep skins, tanned—												
1914-15	29,180	6,209	1,766	8,424	399	45,978	56,36	11,99	3,43	15,89	68	88,35
1915-16	31,553	9,770	1,771	5,803	448	49,345	63,18	19,67	3,73	11,41	78	98,77
1916-17	43,161	16,006	1,738	6,428	399	67,792	1,50,48	43,30	4,73	16,90	1,05	2,16,46
1917-18	9,113	3,175	1,018	964	87	14,357	44,09	12,02	2,91	3,08	33	62,43

tanners could not compete. Eventually the Indian Government was compelled in April 1917, in order to secure and increase the supplies of tanned hides for the War Office, to prohibit tanning of skins altogether in Madras and Bombay Presidencies and to prohibit export of tanned skins from British India. The British Government shortly before, with a view of reserving freight for articles of war importance, had prohibited import of Indian tanned skins into the United Kingdom. Some time elapsed before all the South Indian tanners adapted themselves to the new conditions, but eventually all tanneries—even those previously devoted wholly to skins—became for the time being hide tanneries. At the time of writing the continued demand for army selection hides for the War Office has prevented the resumption of skin tanning, but permission has been given to export stocks of tanned skins held on the 31st August 1918. These include a proportion of skins tanned in the Hyderabad and Mysore States, in which the prohibition of skin tanning was introduced at a later period than in British territory. The temporary set-back to the trade in tanned skins which was rendered necessary by urgent war demands is not likely to be of long duration. Indian tanned goat and sheep skins are probably more certain of their market than Indian tanned hides, and there is evidence that the trade at Home is likely to direct increased attention to them. We learn of the formation recently in the United Kingdom of a Committee on which the Chairman of the Fancy Leather Goods Section of the London Chamber of Commerce is represented, “for the purpose of bringing about a closer co-operation between the traders using East Indian tanned goat and sheep leathers and the manufacturers of the same, with a view of stimulating the manufacture of leathers made from this raw material in Great Britain and making provision for a much larger consumption after the war.”

The prices paid for tanned skins during the war have, as already stated, been phenomenally high and have borne

Prices of tanned
skins during the war.

little or no relation to the cost of production. During the five years before the war the average annual export amounted to 134,826 cwts. valued at Rs. 2,66,85,000, i.e., averaging Rs. 198 per cwt. In the year 1916-17 we find an export of 162,919 cwts. valued at Rs. 4,84,66,000, i.e., Rs. 298 per cwt. As an instance of the phenomenal prices paid

at the London sales, the following figures are quoted of prices paid for tanned goat skins at the sales held in April 1918.

	s.	d.	s.	d.
Goats, prime, Madras	21	6	to	26 0 per lb.
Goats, Town	17	0	„	26 6 „
Trichys and Dindiguls	19	9	„	25 6 „

CHAPTER XI.

FINISHED LEATHER AND LEATHER MANUFACTURES DURING THE WAR.

The statistics given in Tables XXXI and XXXII of exports from and imports into British India of leather and leather manufactures during the first four years of the war show, as might be expected, a decided falling off in imports of European boots and shoes, saddlery and miscellaneous leather goods.

The conditions of the civil trade at home and the absence of freight are sufficient to account for this. The imports of leather belting for machinery continued to be large. The higher values which prevailed for all kinds of leather goods of course make these figures appear larger in comparison with the returns of earlier years than they would be otherwise. Exports from India of finished leather goods during the war have been small. There was a strong demand for all kinds of finished leather in India itself and though endeavours were made by Government to interest the Home authorities in Indian finished chrome leather, no purchases of this leather have so far been made to meet war requirements outside India.

TABLE XXXI.—Exports of leather and leather manufactures from British India by sea to foreign countries. (See also Table XVIII.)

	VALUE IN RUPEES ('000).				
	Unwrought.	Boots and shoes.	Saddlery and harness.	Other sorts.	Total.
1914-15 . . .	1,60	1,04	29	23	3,16
1915-16 . . .	2,46	58	4	20	3,28
1916-17 . . .	12,79	1,08	5	37	14,29
1917-18 . . .	1,22	1,19	10	16	2,67

The orders placed by Government in India for leather and leather articles for war requirements were so large that an account of them is almost a history of the leather industry in India during the war. The capacities of all tanneries and factories capable of producing leather suitable for war requirements were exploited to the utmost.

The Government requirements of army boots have recently been 2,333,000 pairs yearly and to meet these requirements manufacturing arrangements have actually been made in India for 179,000 pairs monthly. The greater part of these have been manufactured by Messrs. Cooper Allen & Co., but five other firms are also employed, and it is expected that from the new tanneries which have been started in Calcutta at least a further 25,000 pairs monthly can be obtained. This is about 20 times the pre-war outturn of army boots. In addition 782,000 pairs of mundah shoes were required in 1918 for which manufacturing orders were placed in Madras, Bombay, Calcutta, Cawnpore and Lahore.

Leather waistcoats also and leather gloves have been supplied in large quantities by Madras manufacturers.

It is, however, in connection with the Government Harness and Saddlery Factory at Cawnpore that the largest orders for leather have been placed with Indian firms. An account of the Factory's operations during the war and the extent to which it was assisted by outside firms is worth recording in detail.

During the year 1913-14 the Factory was working at low pressure and continued to do so until the outbreak of the war. The total output of the tannery in 1913-14 was only 398,741 lbs. of buffalo and cow leather and the value of the Factory outturn of equipment was Rs. 12,60,792-5-9.

On the outbreak of war every effort was immediately made to increase the tannery output and the success attained is shown by the figures of leather tanned in the following years:—

	lbs.
1914-15	851,811
1915-16	1,526,618
1916-17	1,685,402
1917-18	1,799,374
1918-19 (3 months only)	593,659

Details of classes of leather produced in the tannery since 1913-14 with cost (per lb.) of production.

The quantities of leather of various classes tanned in the Harness Factory since 1913-14 and the cost of production is shown in Table XXXIV, page 64.

In calculating the cost of the buffalo leather produced at the Government Factory, allowance has to be made for the fact that the Factory discards the belly portion of the buffalo hide. These bellies are given a quick drum tannage and are sold as a by-product, fetching from 4 to 6 annas a lb. The Factory leather has to bear the loss on sale of bellies, the resultant "backs" being proportionately appreciated in value.

In addition to the leather tanned in the Government Factory, large quantities of tanned leather have during the war been purchased from outside sources, as shown below.

TABLE XXXIII.—*Purchases of tanned leather from outside sources by the Government Harness and Saddlery Factory Cawnpore.*

Source of receipt.	1914-15.	1915-16.	1916-17.	1917-18.	April to July 1918.
	lbs.	lbs.	lbs.	lbs.	lbs.
1. Messrs. Shewan & Co. .	97,728	299,246	306,894	463,537	177,366
2. Sir Adamjee Peerbhoy and Sons, Bombay.	...	109,648	364,636	219,178	...
3. Cawnpore Tannery. .	...	...	...	128,168	138,863.
4. United Provinces Tannery	...	...	...	92,738	131,798
5. Bombay rough tanned hides.	...	...	159,297	433,963	96,244
6. Australian leather imported.	2,339	166,986	457,303	326,501	150,000 (under receipt not included in total.) 20,251
7. Sheep skins, local purchase.	6,461	8,404	7,829	10,299	
TOTAL OUTSIDE PURCHASES.	106,528	584,284	1,295,959	1,674,384	564,522
Harness Factory's own production.	851,811	1,525,618	1,685,402	1,799,374	593,659
TOTAL ALL SOURCES .	958,339	2,109,902	2,981,361	3,473,758	1,158,181

TABLE XXXIV.—Details of classes of leather produced in the tannery of the Government Harness and Saddlery Factory, Cawnpore.

	1913-14.		1914-15.		1915-16.		1916-17.		1917-18.		April to July 1918
	lbs.	Rate.	lbs.	Rate.	lbs.	Rate.	lbs.	Rate.	lbs.	Rate.	lbs.
Buffalo tanned—		Rs. a. p.		Rs. a. p.		Rs. a. p.		Rs. a. p.			
Belting .	38,298	1 6 8	8,411	1 2 9	88,635	1 2 4	62,039	0 15 6	90,773		34,222
Heavy .	64,242	1 5 4	539,100	1 1 8	721,962	1 1 4	561,265	0 14 8	676,353		242,236
Medium .	46,007	1 3 10	42,975	1 0 5	240,813	1 0 0	629,042	0 13 7	889,209		317,201
Light .	4,203	1 2 5	17,396	0 15 5	134,723	0 15 0	Nil	...	Nil		Nil.
TOTAL .	152,750	...	607,882	...	1,186,133	...	1,252,346	...	1,656,335		593,659
Cow-hides tanned	244,991	1 3 0	243,929	1 6 2	339,485	1 7 1	433,050	1 1 3	143,039		Nil
GRAND TOTAL	397,741	...	851,811	...	1,525,618	..	1,685,402	...	1,799,374	...	593,659

Not received.

The currier's shop attached to the Government Factory has dressed all outturn of the tannery as well as all tanned leather purchased. The purchases from Australia consisted mainly of sole leather and of curried harness and bridle leather purchased through the Australian Government and the purchases were made at the following rates :—

		F. O. B.	
		Rs. A. P.	Rs. A. P.
Sole leather		1 4 9	
Harness Back		1 11 0	to 1 11 6
Bridle Back		2 3 0	to 2 4 0

Apart from the tannery the remainder of the Factory was not seriously pressed for many months after the outbreak of the war. The Factory shared equally with Messrs. Cooper Allen & Co. an order for 15,000 sets of Universal Saddlery for the War Office. This order was received in October 1914 and was completed on 13th March 1915, 18 days in advance of the promised date. Stirrups were supplied by the Factory for the whole order.

About July 1915 work began to increase and orders for second class work such as transport gear were given out to local firms. The small local saddlers were gradually trained and after a time these were able to cope with all transport orders, releasing the Factory to work solely on the more important classes of equipment. The firms with whom outside orders were placed included firms in Lucknow, Rai Bareilly, Aligarh, Allāhabad, etc., the firms outside Cawnpore chiefly assisting with metal components. The principle followed in placing all outside orders has been not to call for tenders but to offer firms a fair price based on Factory outturn rates. This system whilst preventing profiteering on the one hand has also prevented excessive competition. The firms have been able to afford to buy as good material as was procurable and have supplied on the whole reasonably good equipment.

Value of—
(a) outturn of Factory,
(b) outside orders.

The total value of the Factory outturn from 1912-13 to 1916-17 has been as under:—

	Rs.	A.	P.
1912-13	12,19,539	8	6
1913-14	12,60,792	5	9
1914-15	20,14,352	4	8
1915-16	38,69,822	11	4
1916-17	52,46,735	12	2

The value of orders placed outside has been—

	Rs.	A.	P.
From July 1915 to March 1916	10,67,992	6	1
From April 1916 to March 1917	59,49,844	13	1
From April 1917 to March 1918	17,43,661	10	3
From April 1918 to July 1918	5,52,237	0	0
TOTAL	93,13,736	0	0 roundly.

Comparison of Factory rates of production and outside orders.

A comparison of rates of transport gear paid to outside firms with Factory production rates is shown in the following statement:—

TABLE XXXV.—*Comparison of rates of Transport Gear.*

NAMES.	Per	Rate paid to outside firms.	Factory production rate, 1914-15.
		Rs. A. P.	Rs. A. P.
Collars, Breast IV	Each	6 4 0	5 5 11
Pieces Buckling	„	0 2 9	0 2 2
Reins, Driving	Pair	8 0 0	6 2 10
Rods, Connecting	Each	1 2 0	0 10 1
Straps, Connecting . . . . .		...	0 13 11
„ Supporting Trace	Each	0 8 0	0 7 4
Traces, Mk. II	Pair	8 0 0	6 6 1

TABLE XXXV.—Comparison of rates of Transport Gear—contd.

NAMES.	Per	Rate paid to outside firms.	Factory production rate. 1914-15.
<i>Pack Saddlery G. S. I. P.</i>		Rs. A. P.	Rs. A. P.
Bits Bridoon, large and small	Each	2 8 0	2 5 2
Breechings, Nos. 1 and 2—			
No. 1	„	3 14 0	3 6 8
No. 2	„	4 2 0	...
Collars Head III	„	4 6 0	3 6 2
Cruppers, No. 1.	„	2 8 0	2 3 10
Girths, Nos. 1 and 2	„	2 4 0	1 14 4
Pannels, Nos. 1 and 2—			
No. 1	Pair	21 8 0	19 8 5
No. 2	„	22 8 0	...
Saddles, P. & D., Nos. 1 and 2	Each	12 8 0	9 10 7
„ „ Swivels	„	3 0 0	0 12 8
Straps metre, Girth No. 1	„	1 2 0	0 14 8
Ropes, Baggage	Pair	4 0 0	3 14 9
Collars, Breast, Nos. 1 and 2	Each	4 0 0	3 13 7
<i>Section 1.</i>			
Belts, leather, Followers	Each	1 4 0	1 0 9
Belts, waist, sword, Sam Browne, S. & T.	„	6 4 0	4 9 1
Straps, bed	„	1 4 0	1 6 9

In June 1917 orders for transport gear suddenly ceased and when later in the year these orders were revived, it was decided to place them outside Cawnpore and to train the Cawnpore firms to assist the Factory in better class work. The Superintendent of the Factory reports that the result up to date has been somewhat disappointing. The first class leather necessary for this work was not available in any appreciable quantities and in workmanship also the firms with some exceptions left much to be desired.

A new cutter's shop was recently completed and taken into use in May 1918. This has enabled the Factory to supply

Cutter's shop.

cut components from their leather to outside firms for all the more important items that they are engaged on. The Factory also has arranged for supervision of the work done and some firms have already shown considerable improvement.

The Superintendent reports that the Factory has received considerable assistance from Messrs. Cooper Allen & Co., Ltd., in the manufacture of equipment, mostly from leather supplied by the Factory. The Empire Engineering Co., Cawnpore, has also given much assistance in the supply of steel and brass components.

In the statement which follows will be found a number of typical

Comparison of pre-war, war-time costs and Home rates for various articles of Factory manufacture.

articles of Factory manufacture with pre-war and war-time costs and Home rates for the same. It will appear that for the leather articles shown in this statement Home prices average 63 per cent. above the Cawnpore Factory rates for 1916-17. Last year's production accounts not being as yet available, comparison only extends to the year 1916-17. It will be seen that there was at first a drop in rates owing to increased outturn and consequent lower incidence of overhead charges. The tendency later on was upwards owing to the fact that an increasingly large proportion of the leather cut up in the Factory had to be obtained from outside sources.

The difficulty of obtaining from Europe many of the leather articles previously imported has given Indian

Manufacture in India of leather articles previously imported.

tanners and manufacturers an opportunity of opening out certain new lines of trade. The Indian Munitions Board has endeavoured to assist this development by refusing priority certificates for import of articles for which they were satisfied that the Indian demand could be met by similar articles manufactured in India.

Considerable progress has been made in the supply of miscellaneous leather goods used in the Bengal jute

Leather goods used in Bengal jute mills.

mills, in replacement of articles previously supplied from abroad. The list of articles given on page 70, all of which are made from cow or buffalo hides, shows the approximate total consumption per month of all jute mills and the approximate quantities now being supplied by local tanneries. The majority of the mills carried large stocks of these articles at the

TABLE XXXVI.—A few typical articles of factory manufacture with pre-war and war costs and Home rates for the same.

Names.	Per	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	Home Rate.
Saddles, S. A., 1902, I. P., II, L. M. & S.	Each	Rs. A. P. 24 2 6	Rs. A. P. 22 6 3	Rs. A. P. 22 10 11	Rs. A. P. 20 14 7	Rs. A. P. 23 15 8	Rs. A. P. 58 2 0
Bits, Portsmouth, Rev. II	"	24 2 6	22 6 3	22 10 11	20 14 7	23 15 8	58 2 0
Stirrups, Steel	"	1 15 2	2 3 4	1 11 8	1 13 11	2 3 11	1 14 0
Reins, Bit, II	"	1 8 0	1 8 0	1 0 1	0 13 7	1 1 1	1 10 0
Leathers, Stirrup	"	1 6 6	1 3 9	1 3 7	1 4 4	1 5 1	3 1 0
H. P. D. Collars, Breast, III	"	0 15 9	0 13 9	0 14 3	1 0 5	1 0 5	2 7 0
" Breccplings, I. P.	"	12 3 3	11 8 0	10 11 0	14 2 0	10 3 7	24 0 0
Traces, wire, long, N. & O.	Pair	7 6 10	10 0 11	9 6 3	12 1 10	12 2 10	21 3 0
Traces, wire, short	"	7 6 10	7 9 11	7 2 5	7 3 6	7 7 0	24 0 0
B. E., Bandoliers, 50 rds., L. M. S.	Each	3 6 5	5 15 7	5 10 9	5 5 2	5 4 0	10 4 0
" Belts, Waist, L. M. S.	"	0 14 11	3 1 0	3 2 11	3 10 6	3 12 11	3 9 0
Belts, Waist, Brown, Sword, Sam Browne L. M. S.	"	4 2 11	0 13 7	0 13 9	0 14 6	0 15 4	2 4 0
Belts, Shoulder, Sword, Sam Browne	Pair	0 13 5	4 8 6	3 10 11	4 13 9	5 1 0	4 9 0
Boxes, P. T., Ammn. B. L., 2-75", Shrapnel or Lydite.	Each	...	1 2 5	1 5 9	1 10	1 10 1	1 13 0
Boxes, P. T., Ammn., B. L. 10-pr., common, shell, I. P.	...	...	...	51 0 10	...	50 3 11	...
Boxes, P. T., Ammn., B. L. 10-pr., Shrapnel I. P., N. & O.	Each	54 14 2	53 14 4	...	57 13 10	58 12 2	93 12 0
Boxes, P. T., small, stores, B. L. 10-pr., I. P.	"	69 10 1	68 5 6	75 9 3	68 11 5	...	93 0 0
Boxes, P. T., Artificers	"	58 7 4	52 3 5	51 13 9	53 14 9	54 6 2	73 5 0

commencement of the war and stocks were maintained up to the end of 1916 by supplies from Home. Since then certain quantities have been coming through without priority, but stocks have recently become fairly low and the demands on local manufacturers have increased. Considerable quantities of belting and pickers have been received from Australia and Japan respectively. It is reported that the quality of the articles manufactured locally is improving and is generally considered as satisfactory.

Name of Articles.	Approximate total consumption per month of all mills.	Approximate quantities now being supplied by local tanneries.
Picking bands	180 cwts.	20 per cent.
Belt laces	170 "	12 "
Leather belting	60,000 feet.	5 "
Martingale straps	80 cwts.	10 "
Pump leather hides, etc.	20 "	20 "
Covering leathers, i.e., leather on edge, leather on flat	60 "	6 "
Loom pickers	58,800 pieces.	10 "

Considerable success has also been attained in the manufacture of roller skins for use in cotton mills. The production of these skins is a highly specialised branch of the light leather trade and mill-owners throughout the world generally prefer the British made skin. It is a matter therefore for congratulation that Indian tanners have made a great advance towards meeting the requirements of Indian mills. The Bombay Mill-owners Association's estimate of the consumption of roller skins in cotton mills in India is 400,000 skins annually, or about 700 dozens weekly. The standard of consumption in Lancashire Mills is given by a recognized authority as four skins per week for every 10,000 spindles, but for various reasons, climatic and other, the average expenditure for this country is put at a dozen skins for the same period. The complaints generally made against the Indian made roller skins are (1) that they are inelastic and therefore split when being put on the roller or get loose after being put on, (2) that they are uneven, either because the hair is not completely removed, or because there are blemishes, or because the skin was originally not of uniform thickness, and (3) that the prepared side is not smooth and glossy enough. While these defects, or at least some of them, are not uncommon, a large number of good skins are now produced and several manufacturers have expressed themselves as quite satisfied with Indian made skins.

The production in India has developed so rapidly that in October 1917 four of the chief manufacturers were placing 750 dozens of roller skins weekly on the market, a figure in excess of the consumption of the cotton mills, and the outturn in India may be estimated now at about 1,200 dozens per week. The excess not required in India is being exported, principally to Japan. The following eight firms are at present engaged in manufacture of roller skins:—

Messrs. Skippers & Co., Ltd., Cawnpore.

Messrs. Randelia & Co., the Navsari Leather Works, Navsari.

The Chrome Leather Co., Madras.

The Mysore Tannery Ltd., Bangalore.

The Western India Army Boot and Equipment Factory, Sion, Bombay.

The South Indian Leather Co., Madras.

The Berhampore Leather Manufacturing Co., Berhampore, Bengal.

The National Tannery, Calcutta.

Another important accessory used in textile mills is the "picker."

Pickers for jute and cotton mills. The annual requirements of the Indian jute mills are estimated at over half a million pickers: Indian cotton mills are said to have used $1\frac{1}{2}$ millions before the war and their present requirements owing to increase of work and the falling off in the quality of pickers, are believed to have risen to $2\frac{1}{2}$ millions. The making of pickers is a highly specialised trade in Great Britain and the Buffalo Picker Makers' Association claims before the war to have supplied 90 per cent. of the demands of the whole world. Pickers are made by machinery from raw hides or leather and require to be soaked in oil for six months and after that put away to season for another six months, before they are ready for use.

No organised attempt has as yet been made to manufacture pickers for cotton mills in India. A few have been made by hand especially in Ahmedabad, and though their lasting qualities are poor, they are cheap and have helped the mills to tide over the difficulties caused by the war. In Calcutta, however, Messrs. Graham & Co. and one or two other firms have attained a fair measure of success in making pickers for the jute mills, although their output is still far from sufficient to supply the total demand. It is reported that the average life of the Indian-made picker

is about 800 hours as against the 1,000 hours of the British picker. The reason no doubt is, that the pickers made in this country have not been given a chance to mature properly, owing to the great demand for them, but there is every reason to suppose that as the trade develops and stocks are able to season, the standard of the imported article will be reached.

Before the war, manufacturers in India seem to have been almost entirely dependent on imported belting. *Leather belting.* for their machinery and a very large trade was done in this commodity, the greater part of the imports coming from the United Kingdom, as the following table shows:—

TABLE XXXVII.—*Imports of belting for machinery of leather and other materials into British India.*

Articles and countries of origin.	VALUE.					
	1912-13.	1913-14.	1914-15	1915-16.	1916-17.	1917-18.
<i>Belting for machinery (a) of leather.</i>	£	£	£	£	£	£
United Kingdom . . .	130,178	155,673	122,932	151,782	181,396	250,094
United States, America . . .	5,398	6,980	6,090	12,750	19,813	9,433
Other countries . . .	2,509	4,874	3,293	2,022	1,839	7,952
TOTAL . . .	138,085	167,527	132,315	166,554	203,048	267,479
<i>(b) of other materials.</i>						
United Kingdom . . .	97,099	100,536	98,951	139,558	162,604	260,309
United States, America . . .	613	1,745	1,389	1,891	2,450	4,386
Other countries . . .	9,440	12,129	7,136	1,053	997	4,807
TOTAL . . .	107,161	114,410	107,476	142,502	166,051	269,502
TOTAL OF BELTING OF ALL KINDS.	245,246	281,937	239,791	309,056	369,099	536,981

It will be seen that about half the belting used was made of leather and that the value of the imports has nearly doubled since the beginning of the war. This is, however, largely due to the rise in prices, as the manufacture of belting and driving ropes has increased in India during the war. Both chrome leather and vegetable-tanned leather beltings are made. Some of the chrome leather belting, when tested by the Director of Ordnance Factories, proved very satisfactory. The belting stretched less than 4 per cent. in the first fortnight and less than 1 per cent. in the next. It also stretched evenly and rode the pulleys properly, the jointing and

lacing being good. When tested on a machine, it gave a breaking strain of 6,810 lbs. per square inch. Considerable prejudice still exists, however, against Indian-made belting and complaints are often made that it has not a uniform thickness, that the cement jointing is often not good and that some makes stretch unduly and unevenly.

Moreover, even the best makes are said not to last so long as English-made belting. As in the case of roller skins and pickers, this industry has not only to contend with the experience and organization of a specialised trade, but it is also hampered by the vested interests of the agency houses, both European and Indian.

Sheepskins chrome-tanned with their full fleece are used in rice mills for polishing rice. Large skins measuring about 4 ft. by 3 are required and the fleece should be quite $3\frac{1}{2}$ inches long. Hitherto only skins imported from the United Kingdom have been used and it has been estimated that the consumption in Burma alone is 10,000 skins a year, costing normally on an average from Rs. 15 to Rs. 18 each. In order to avoid demands on the United Kingdom for leather and to make the mills as far as possible independent of other countries for essential accessories, attempts have been made to encourage the use of Indian-made skins and these have met with fair success. The difficulty with regard to Indian sheepskins is that they are as a rule small and have a very short fleece, when compared with the skins imported from the United Kingdom. Their quality, probably owing to the inexperience of the manufacturers and their workmen, is also very uneven at present and although they can be supplied at rates appreciably cheaper than the war-time rate of Rs. 30 for imported skins, they have not displaced the English sheep skin. The greater amount of grease contained in the fleece of the English skin makes it specially suitable for this class of work. Some Indian manufacturers, however, who have been able to secure superior skins of a specially large size find that they are nearly, though not quite, equal to the English skin in point of quality, while they compare favourably in price. As a result of the trials it has made, one firm has now given a large order for Indian skins and there seems reason to hope that this line of manufacture has become established in India.

CHAPTER XII.

POST-WAR DEVELOPMENTS.

The object of this Review has been primarily to record facts, not to make suggestions. The history of Glacé kid and chrome tanning. and the past is, however, pregnant with suggestions for the future development of the Indian tanning industry. The possibilities of development and the conditions and limitations of the problem have been clearly and authoritatively stated in an Appendix to the Report of the Indian Industries Commission, to which all who are interested in this industry should refer. The report emphasises the strong position which India can attain by the development of chrome tanning for the manufacture of glacé kid from her goatskins and of box sides and box calf from her hides. Regarding these industries Mr. Charles Scriven, an acknowledged authority in England, writes: "Glacé kid and chrome leather that, with few exceptions, were struggling industries before the war are now healthy, vigorous undertakings and show full possibilities of great expansion and development." India is in the strong position of possessing the largest store of suitable raw materials for these industries, while the possibility of successful chrome tanning in this country is already proved.

In conclusion a word may be said about Indian tanstuffs which are dealt with in Part III of this Review. Indian tanstuffs and tannin extracts. The necessity for maintaining supplies of Turwad bark for the trade in East India Kips and tanned skins has already been emphasised. Babul and a great variety of other valuable tanning barks and leaves exist in almost unlimited quantities and their use is capable of great extension. The results of recent research published in Part III of this Review are at present only of a preliminary character, and much further experience is required of actual tanning results before the value of most of these tanstuffs can be determined. There is a wide field for research of which only the surface has been touched.

There is also an opportunity for developing an export trade in Indian tanning materials. Hitherto the export of Indian tanstuffs has been mainly of Myrabolans from India and Cutch from Burma.

Though large quantities of Myrabolans are in the aggregate used by Indian tanners, there remains and will remain a very big surplus for export. Attention may, however, well be directed to the manufacture for export of solid extracts from Indian tanstuffs and Mr. Pilgrim's paper in Part III of this Review deals with this subject. There is already a small export trade in Myrabolans extract from India. The existence of a good market after the war for tannin extracts of suitable quality seems assured. During the war the scarcity of tanning materials has been felt almost as acutely as that of hides, and the demand which has been made on existing sources, *e.g.*, Quebracho from South America and Chestnut extract from France, are likely to result in reduced supplies of these tanstuffs in the future. The manufacture of synthetic tannins also has not been as successful as was hoped. Attention is therefore likely to be directed to the exploitation of new tanning materials, and especially to the manufacture on the spot of solid extracts in the Colonial Possessions of the Allies in view of the high cost of freight which is likely to continue for some time.

This prospect should be of interest to India, and particularly to Burma where there are immense quantities of Mangroves, some of which are practically identical with those already used elsewhere, *e.g.*, in Borneo and Madagascar, for manufacture of Mangrove extract. The manufacture of an extract however which will command a good price in the Home markets is a subject to which much further research needs to be devoted. Several years ago attempts to pioneer this industry which were made by the Burma Forest department proved a failure. The extract produced contained excessive red colouring matter and excessive moisture and was irregular in its tannin content. It failed to fetch more than 10s. 6d. to 11s. per cwt. c.i.f. Liverpool, little more than half the price of the Borneo extract. Further research is now however being undertaken by the Government Tannin Expert with the object of removing the defects disclosed by the earlier experiments. The results of this research will be published in due course.

PART III.

CHAPTER XIII.

* INDIAN TANSTUFFS AND THEIR TANNAGE,

BY W. A. FRAYMOUTH AND J. A. PILGRIM.

In response to many requests to publish the results of our investigations from those who have started to develop the tanstuff resources of India, we have decided to publish all that has been observed so far, knowing that much that we have put down may be modified in the light of further research.

So little is known of the tanstuffs of India and their application in leather manufacture, that our two years' work together has only shewn us that we have scarcely touched the edges of this field of research. The fact that we learn something new about the tanstuffs we are studying, almost daily, urges us to state clearly that proposing to re-edit our records yearly, we submit this information tentatively. We will be glad to give revised information to any one who cares to write to us from time to time.

In this report we have followed Hooper's earlier system of classification.

Such tannin values as are given below represent the average that we have deduced from Mr. Pilgrim's and others' analyses. Full details of all analyses have been compiled by Mr. Pilgrim: (see from p. 112 onwards). All analyses figures are given in terms of absolute dryness of the sample.

In this earlier section we have aimed to record practical details of collection and applications of tanstuffs to leather making, in order to help the tanstuff collector and the tanner, while Mr. Pilgrim's analysis record is presented for reference to prove how we have arrived at our conclusion. Wherever costs of collection appear, they are given "under the tree" unless otherwise specified. To this figure must be added supervision, cartage, forest royalty, packing freight, etc., all of which will vary in different localities. All costs so given have been proved on the large scale.

* This article was originally published as Bulletin No. I of the Government Tannin Research Factory, Malhar.

XVI.—TERNSTROEMIACEÆ.

TEA.

Camellia thea. Linn.

Hooper states that the leaves of the Tea bush contain about one-fifth of their weight of tannin.

Messrs. Kilburn & Co., of Calcutta, sent a sample of "tea fluff" to the Tannin Expert to Government in October 1917. He reported 8.38 per cent. as the amount of tannin found. Later, it was found that the market value of this product is as high as Rs. 15 per maund. As a tanstuff it would not be worth 8 annas per maund. Doubtless the high price obtained for it is due to its content of Thein (Caffein).

XVII.—DIPTEROCARPACEÆ.

SAL.

Shorea robusta.

Sal Bark.—Hooper states that in 1886, efforts were made by the Forest Department to utilise this bark, of which a large quantity was then available from yearly fellings from the forests of the United Provinces.

Since then the number of trees felled yearly in the United Provinces, Bihar and Orissa, and Central Provinces, has increased enormously, and the quantity of bark allowed to rot in the jungles is very large indeed.

Hooper apparently formed the opinion that the amount of tannin in the bark was low. Pearson gives many results which vary greatly.

Messrs. Cooper Allen & Co. have used Sal bark in their tannery for some time with success. Cawnpore is favourably situated near to the Sal forests of Gonda and Bharaich, and as the bark costs nothing to get, it has been possible to pay for the carriage of the bark in strips, to yield the tanner a 5 per cent. to 8 per cent. product.

Our results vary considerably, from 3 per cent. to 9 per cent. tannin, with about 8 per cent. of non-tannin, which relationship does not promise well for extraction and solidification.

We have found that if this bark is put through a disintegrator, and if the dust be driven off the fibre into a settling chamber, that

SAL—cont'd.

the ordinary bark is separated into a powder containing 12 per cent. tannin, while the fibre left behind contains only 3 per cent. tannin. It is thus clear that the fibre (no matter how useful it may be as a fibre) should not be sent to the tannery. It will probably be possible to erect a simple plant in the jungle consisting of an engine, disintegrator, a fan and dust chambers, which would produce a Sal-dust tanstuff with from 12 per cent. to 15 per cent. tannin, which would occupy just one-seventh of the space that is occupied by the original bark. See Section J of the Director's First Annual Report to 31st March 1918.

Sal Leaves.—The fully grown leaves are so difficult to pack or crush, that in spite of the fact that they carry from 8 per cent. to 10 per cent. of tannin, we regard the product as unworkable.

The young leaves dry brittle, and with their twigs (with 7 per cent. tannin) might be beaten into a powder in the jungle. We are not certain yet of the average tannin value of the product that may be expected on the large scale, but we have results showing as high as 23 per cent. tannin.

Tannage.

Sal bark alone produces a very tough leather, with a reddish tint. A mixture of two-thirds bark and one-third young leaves produces an excellent leather of a pale colour; penetration is very slow. The most successful application of Sal bark that we have made was in mixture :—

	per cent.
Karunda leaves	33
Gothar	33
Sal	33

This half tan was pale in colour, very tough, and when re-tanned and curried presented a very fine leather. We know of no better and cheaper mixture of tanstuffs for half-tan tanneries that might be started in the Terai of the United Provinces.

Much more work must be done on these tanstuffs.

*The "IRON WOOD" of Malabar.**Hopea parviflora.*

The bark is fibrous and very similar to Sal in appearance. The remarkably high proportion of tannin to soluble non-tannins of

IRON WOOD—*contd.*

the mature bark points this out as a tanstuff which may be tried for extracts. It should theoretically be possible to get well over 60 per cent. tannin (see section D of the Director's First Annual Report to 31st March 1918), but the presence of anhydrous "reds" may militate against this. The bark is at present a waste product from the timber and should, therefore, be very cheap.

XXXV.—RHAMNACEÆ.

JHARI BER.

Zizyphus nummularia.

With the idea of finding a use for this very widely spread bush, we made several experiments to collect the leaves and the twig bark in lots of several maunds. The results went to show that it would cost at least Rs. 2 per maund to collect either leaves or bark, while the leaves carried only 9 per cent. and the best bark 11·7 per cent. of tannin. The bark produced a plump and strong leather, but the colour was very poor. This tanstuff does not promise well.

GOTHAR.

Zizyphus xylopyra.—(Gothar, Ghont, Ghat bar, Kottai, etc.)

This fruit, in appearance like a small plum, when green dries to look like a gall. It contains a large hard stone with a thin covering of flesh. These fruits have long attracted the attention of the tanner, and their properties are known to every *chamar*. The infusion, cold or hot, is full of glutinous matter, which is difficult to filter. This glutinous matter is very troublesome during analysis. A Gothar infusion will not pass through such a filtering medium as the sand in "Proctor's Extractor", nor will it pass through cloth, muslin, etc., but with difficulty it can be filtered through Berkefeld filter "candles," the gum being left behind. The addition of acid or alkali removes the gummy effect which rather indicates an albuminous character for the glutinous matter. It is noteworthy that the non-tannin liquor is much less gummy than was the infusion before the agitation with chromed hide powder.

GOTHAR—*contd.*

When Gothar is used in any large proportions in mixture with other tanstuffs, in direct contact with the hide, it causes crack in the grain, and we fear the crushed fruit can never be worked in a press leach. It is probably because of these troubles that Gothar has been condemned by all the tanneries.

Puran Singh had examined this fruit at different stages during its growth, and his figures seemed to point to a maximum quantity of tannin at the stage when the fruit is of full size, but still green on the tree.

We found at an early stage that the tannin of Gothar penetrates the hide very rapidly, almost as rapidly as that of Turwad.

In view of these facts :—the enormously wide distribution of the tree ; its prolific crop of fruit and the cheapness with which this can be collected,—we were led to make regular tests during the growth of the fruit in the fall of 1917.

The immature green fruit on the trees at the end of July shewed $16\frac{1}{2}$ per cent. tannin in the flesh, while the stone shewed 4 per cent.. The flesh of the fruit nearly full-sized, but still green, taken from the trees in September, shewed 23 per cent. while some taken in October shewed 21 per cent. A still more mature but green sample shewed 22 per cent. Finally a sample of green dried flesh prepared by Mr. Samson of Ganjam gave 34 per cent. as a result of a lead test.. This was unconfirmed by hide powder analysis, and cannot be relied upon. Large scale experiments were made in the preparation of the flesh by crushing when green to remove the stones, but the cost of the resultant dried flesh (over Rs. 2 per maund) drove us to find a cheaper method of preparation. We have found, in innumerable cases, that the unbroken fruit will not dry out properly, with the result that the heap of fruit gets hot, ferments and turns into a useless slimy mass. If the fruit is left to dry on the tree, or on the ground when it falls in January, worms and borers attack it and leave an almost tanninless product. Finally we learnt that the right way is to gather the fruit during October, November and December, while green ; to break each fruit ; to allow it to dry out thoroughly, and to send to the tanneries in this state, flesh and stones mixed. We have stored big quantities of this in this state for several months with safety. The average of this product is 16 per cent. tannin with about the same amount of

GOTHAR—*contd.*

non-tannin. Its cost "under the tree" will not exceed 8 annas per maund, and it should reach any tannery in India at Re. 1 per maund as soon as regular collection is introduced. The quantity available is unlimited in most years. We would warn consumers not to buy the fallen fruit. None should be collected after January in the Central and Northern parts of the country.

Tannage.

Wishing to avail ourselves of this, the cheapest tanstuff, with the added advantage of rapid penetration of the hide, we worked to find a way to get over the glutinous matter difficulty, and we found that if the dried fruit is milled to a fine powder (as fine as possible) this powder can be added at the head of a series of suspension pits, up which the hides are moved daily, and by occasional plunging, the tannin and the glutinous matter of Gothar produce a dense liquor, which is not too rich in tannin, as is desirable during the early stages, but which can be enriched gradually as the state of the hides requires and which has a most excellent effect in the colouring stages of tanning. We traced this to the colloidal glutinous matter before we read in the *Leather Trades Review*, January 9th, 1918, that Turnbull and Carmichael of Liverpool had taken out a patent for the addition of jellies to solutions of tannin, thus allowing very strong solutions of tannin to be used without causing the grain to be drawn. Starch mucilage or some such dense colloidal medium is added by which means, it has been found possible to offer very strong tannin liquors to the hide and so accelerate the progress of tanning without harm to the resultant leather. We believe that in Gothar, we have found a natural mixture of tannin, and other colloidal medium which may be applied in the same way.

There is much to be learnt yet in this direction, but with 8 pits with 25 hides in each (average limed weight 25 lbs.), 300 lbs. of powdered Gothar can be added each day to the top pit and the hides may be moved up this series in 8 days to be tanned later in any suitable manner with other tanstuffs to produce excellent leathers. Everything indicates that the treatment may be extended to 16 days, by when an ordinary kip is struck right through. Our experiments in this direction are not yet concluded.

GOTHAR—concl'd.

The liquors in these suspenders become acid after 6 days and afford a bate that is gentle and thorough. At Maihar we have been able to do without other bates with cow hides for upper leather. After washing nearly free from lime the hides are suspended in the sour liquors, which produce a blue black colour on both the sides of the hide at first. After two days in the weak Gothar suspenders, the whole of the colour clears, the hides swell up in a remarkable manner and after 6 days, take on the most perfect colour that can be desired. Thus while Gothar penetrates well, it is self-bating and "colours" well.

We recommend that the tanneries should now try this tanstuff and this method in a small way at first, or visit Maihar to see this application of Gothar in the tannery, for Gothar offers *unlimited* tannin at one anna for each one per cent. of tannin to every tannery in India.

XLI.—ANACARDIACEÆ.

KASHEW NUT TREE.

Anacardium occidentale.

This tree is a native of South America, but it seems to have thoroughly acclimatised itself in various tropical countries. The trees are very abundant all over Madras. We found the tannin in a sample of the bark to be 9.43 per cent. The proportion of tannin to non-tannin is almost equal. ($\frac{1}{1}$).

RHUS.

Rhus mysorensis twig bark. (Dasni, Danonia, etc).

The twig bark infusion gives a blue black with iron salts and the tannin seems nearer to the pyrogallol type than that in the leaves, which leans more to the catechol side than that of the ordinary "SUMAC" (of *Rhus coriaria*). The twig bark shewed $18\frac{1}{2}$ per cent. tannin. An analysis of leaves picked from the twig bark sent to us (and therefore a small sample and not quoted in the list of analyses), shewed 13 per cent. tannin and 14 per cent. non-tannin. We have now received from Madras, bulk samples of

RHUS—*contd.*

the bark, which would seem to be the more valuable product for practical tests.

Tannage.

Penetration was rapid during the one tanning test we carried out with the twig bark. The colour of the leather was a cream, the grain was slightly drawn, but generally speaking, the fibre was long and tough and most excellent leather can be produced from this tanstuff.

XLV.—LEGUMINOSÆ.

BABUL.

Acacia arabica. (Karu, Velam, etc.)

The bark from felled trees has constituted the most important tanstuff of Northern India. It is for the reason that the tree must be felled before the bark can be taken that we have not paid much attention to the latter as a tanstuff. Further, the tanners of Cawnpore know all that there is to know about Babul. Over 500,000 maunds per annum are being consumed in the great tanneries of that city. The average tannin content of the bark as brought in, is 12 per cent., the bark of the bole when cleanly taken will shew up to 18 per cent. while the twig bark is poor: 7 per cent.

The history of this tanstuff contains a lesson that we would urge should be learnt and thus avoid what might, in other circumstances, have been a calamity. When the tanning industry started in Cawnpore, the whole surrounding country was full of Babul. The earliest supplies were sold for 8 annas per maund or less, and as soon as the demand increased there were those who developed a business in the sale of the timber, thus helping to realise better values from the trees and keeping down the price of the bark. For many years the price of bark remained at about 12 annas. Then, as gradually the whole of the neighbouring country was stripped the price rose to Rs. 1-4 just before the war. Then when the tanneries were suddenly called upon to turn out enormous quantities of leather, it was found that there were no supplies of Babul in sight. Messrs. Cooper Allen & Co., Ltd., had long urged the re-planting of the tree and a little was done in this direction. In 1915 it became

BABUL—*contd.*

necessary to use every influence that Government could apply with the result that the tanneries got in big quantities in that year and in 1916, but no one knowing the situation hopes that proper quantities will be available after the war except at prices neighbouring on Rs. 2 per maund.

The moral of this is that no industry should lean on supplies of a tanstuff, to take which the tree must be felled, with the one exception where a bark is a bye-product from yearly fellings for timber.

Tannage.

The tanneries of Cawnpore all mix from $\frac{1}{5}$ th to $\frac{1}{3}$ rd of myrabolans with Babul bark to obtain their tanning liquors, probably to get denser tanning liquors, to produce acidity, and perhaps to try and overcome Babul's natural tendency to produce a dark-coloured leather. Our experience has shewn that this use of myrabolans in the early stages of tanning causes crack of the grain.

Experiments that we have conducted to overcome the harshness of Babul leather (as generally produced, and not the perfect leather tanned by exceptional tanners) have shown that Karunda up to $\frac{1}{3}$ rd in mixture with Babul, not only strengthens the fibre and grain, but bleaches out the red of Babul.

WATTLES.

The wattles grown in South India are principally of three species, *Acacia decurrens*, *A. melanoxylon* and *A. dealbata*. Of these three species, the first named has been generally reported to yield the bark richest in tannin, whilst *A. dealbata* is generally regarded as the weakest. We had endeavoured to obtain from the Forest Department a typical mixed sample of barks of these three species, roughly in the proportion in which they occur, but by some mistake pure *A. dealbata* bark was sent to us, and the analysis of the average sample from the bulk of this bark shewed only 11.85 per cent. of tannin. A party in Madras have, we understand, a scheme on hand, for the cultivation in the Nilgiris, of the *A. decurrens* as a tanstuff. This wattle (a sample grown in India) has been reported to contain as much as 42 per cent. of tannin.* Some preliminary work done

* A two-bag sample analysed recently at Maihar shewed 43.27 per cent. tannin with 8.22 per cent. soluble non-tannins.

WATTLES—*contd.*

by one of us on the wattles of the Palni Hills, Madras, shewed very clearly that the leaves of all the three species contain only a trace of tannin. There was still very little tannin in their twig barks although there was considerable indication of "non-tannin astringent substances" (Gallic acid).

The Conservator of Forests, Southern Circle, Madras, does not consider that with the present demand for wattle timbers, more than a hundred tons per month of bark from fellings of all three species would be available for tanning purposes.

CUTCH.

Acacia catechu. (Khair, Karangalli, etc.)

Cutch or Catechu are names given to liquid or solid extracts obtained from the wood of the *Acacia catechu*. They may or may not have had the crystallisable Catechin removed, the latter product being used in the manufacture of "Pan." The leather produced is very harsh and Cutch could not be recommended for self-tannage.

The majority of the so-called "cutches" of the market which are largely employed in cheaper tannages, are in reality extracts of various species of Mangrove having properties similar to, but not identical with, the true cutch.

The bark of the *A. catechu* or Khair tree would seem to contain a somewhat different tannin and though the bark is not a rich one ($7\frac{1}{2}$ per cent.), it can be got from coppice shoots at a low cost, and there are large quantities available.

Tannage.

We have only made one tanning test with Khair bark, but beyond the fact that rather a lot of bark was used, this was most successful. The leather was supple, very tough, without crack, but the grain was a little drawn.

DIVI DIVI.

Cæsalpina coriaria—the true Divi Divi, is a native of the West Indies and Central America, but it has been very successfully cultivated in various parts of India. Hooper states:—"Professor Dunstan's reports shew that the pods from the cultivated plant from Bengal give an average of about 30 per cent. of tannin." But our

DIVI DIVI—contd.

sample from Madras with 44.52 per cent. of tannin was much better than this.

TERI PODS.

Cæsalpina digyna.

It has been suggested that *Cæsalpina digyna* (Teri Pod), the true Indian product, common in Burma, Assam, Bengal, etc., could be used with advantage as a substitute for Divi Divi. It has been stated that the shell without seed has analysed over 50 per cent. and even up to 60 per cent. tannin. But a commercial sample with seeds removed, gave us the relatively disappointing result of 41.5 per cent of tannin.

Tannage.

Several trials were made with Madras Divi Divi in mixture to produce a half-tan leather. We hoped that the fine pale colour it exerts on leather and its rapidity of penetration would have been very useful. In all cases, however, it caused stiffness and density in the leather which were the opposite of what was required. There are many other directions in which such a rich tanstuff will be used. We found that the rate of penetration was very fast indeed.

TURWAD.

Cassia auriculata. (Avaram ; Turwad ; Avla).

This very well-known and exceptional tanstuff is used in very large quantities in the South and West of India. We would estimate the present consumption in the tanneries making war leathers at 80,000 maunds per month ! The usual product delivered to the tanneries carries 18 per cent. tannin and 9 per cent. non-tannin.

The bush grows wild in the South and West of India and in Rajputana. When two to three years old, the branches or twigs which spring from the root are cut right down. The twig bark is stripped off and dries in small cornets. We think that much labour and money might be saved if the collectors would adopt our method for stripping twig bark. (See section B of the Director's First Annual Report to 31st March 1918.)

TURWAD—*contd.*

The coppiced root sends out a very large number of shoots and a new harvest can be taken after a year. The twig bark can be got at a cost of Rs. 1-5-0 per maund "under the tree."

The average price paid for Turwad bark before the war was about Rs. 3 per maund, although some tanneries nearer to supplies paid less than this. Throughout the war, the price has ranged from Rs. 5 to even Rs. 15 per maund. These prices and the enormous demand have caused many areas to be stripped of Turwad in such a way that it will be three to four years before regular and full supplies can be expected again.

The bush has been successfully grown in Central and Northern India. Messrs. Cooper Allen & Co., who have urged the cultivation of Turwad for many years, have a plantation at Cawnpore. Lately experiments have been made by the United Provinces Forest Department at Etawah, which shew that the bush will grow rapidly to a great height in that locality. A sample of the bark was sent to us and after analysis and tanning tests, we reported as follows:—

"The sample was picked over and cleaned free from stick and dust. 2.71 per cent. dust and 5.4 per cent. stick was rejected.

"In practice, the collection of the bark would have to be more carefully done.

"The Tannin Expert to Government carried out an analysis on the clean twig bark with the result:—

	Per cent.
Tannins absorbed by chromed hide powder	19.51
Non-tannins	14.69
Insolubles	65.80
	<hr/> 100.00

"Colour in filtered infusion calculated to 5 grams per litre tannin strength:—

Red 4 units. Yellow 8 units.

"A piece of slaughtered cow-hide was taken after 20 days liming bran bate, and sour Go har liquor 'colouring' on 28th February 1918. The butt was then tanned exactly according to Bombay practice. When the first bark was rejected,

TURWAD—*contd.*

the Tannin Expert to Government analysed the uncrushed exhausted reject as follows :—

	Per cent.
Tannins absorbed by chromed hide powder.	5.11
Non-tannins	2.26
Insolubles	92.63
	<hr/> 100.00

“In this respect the Etawah Turwad is better than many samples from the South of India that we have tried. The average of the Bombay reject or uncrushed bark shews 8 per cent. tannin.

“Tanning was continued until April 1st, 1918. After two days' treatment in crushed Myrabolans, the leather was oiled and dried.

“Total time soak-lime-tanning 54 days, which is as quick as with Turwad bark of the South.

“A sample of the leather is enclosed.

“The results are such as to demonstrate beyond any possible doubt that cultivated Turwad from Etawah will be equal in every way to the Turwad of the South of India, and if carefully collected will be of much better quality than the usual bark of the South. I believe equally good bark can be grown all over India.

“I would again urge wide cultivation of this species. I feel certain that the price offering for the bark will never be less than Rs. 3 per maund and that there will always be a demand. From experiments lately carried out by an experienced tanstuff collector, the cost of producing clean dry bark should not exceed Rs. 1-12 per maund, allowing for interest on capital during the first two years when the bark cannot be taken.”

Mr. J. W. Henderson, War Office Representative, who has reported on this leather, states :—

“..... that it is excellent and fully equal to the prime tannages of Bombay and Madras Presidencies. He adds that the importance of cultivation of *Cassia auriculata* cannot be over-stated, as without abundance of this tanning

TURWAD—concl'd.

material at something like pre-war prices, viz., Rs. 15—25 per candy of 500 lbs. the tanning industry in India will never be thoroughly developed. The Indian Munitions Board concurs in the view of the supreme importance to the development of the tanning industry of the increased cultivation of *Cassia auriculata* bark not only in Madras and Bombay Presidencies, but in other parts of India, where recent experience conclusively proves that the plant can be grown satisfactorily."

AMALTAS.

Cassia fistula. (Sonari; Konnai.)

This bark, the Konnai of the South, is used very largely in admixture with Turwad bark. We have been puzzled to form a proper estimate of its tannin contents. While some samples of the twig bark shew as low as 3 per cent. tannin others show as high as 15 per cent.

If, as we suspect, the average tannin is not higher than 10 per cent. in this bark, the prices that the South Indian tanner has been paying are out of all proportion to its value. We have discarded, because of their cost, several Northern tanstuffs, the unit of tannin of which comes to not more than half of that of Konnai.

Tannage.

Amaltas produces a very smooth-grained leather, but not so smooth as that from Turwad. The colour of Amaltas leather is very pale indeed, almost white. Amaltas mixes well with Babul for the production of half-tan leather.

MAHURAIN.

Bauhinia vahlii. Mahurain.

This huge creeper has given great trouble to the forester, for it climbs to the tallest of Sal trees, and much of it has been cut out in reserved forests. It grows again when cut down, and there is a large amount available in the Terai and in Central Provinces. We have been greatly puzzled in our attempts to find where the tannin

MAHURAIN—*contd.*

lies. There is no bark in the proper sense of the word, and the extreme outer skin has always shewn itself poor in tannin. The centre cores of big logs are nearly barren. Perhaps the best tanstuff from this species that we have seen, is relatively small logs of the creeper torn up into shreds including bark, core and everything. Small creepers can be chopped up in a chaff cutter, to yield small enough pieces to pack well for transport. Altogether, the difficulty of dealing with the very tough fibre and getting the stuff to pack properly makes Mahurain relatively a very expensive tanstuff. There are however very great possibilities in the attempt that must be made as soon as suitable machines could be got from Europe, after the war, to "comb" out the cementing matter that lies between the fibres and contains practically all the tannin. Small experiments demonstrate that the combed out fibre will be white and clean and will be of great value as a fibre, even for local consumption alone. Further, we have found that by milling the creeper, a fine wool is formed which contains a minimum of tannin, while the dust blown from the mill is rich in tannin.

Tannage.

The colour produced on leather is a pale cream; in rare cases, stains of an orange colour appear; Mahurain's effect on the grain is perfect, making for great smoothness and elasticity. It keeps the pelt in a swollen condition, but its penetration is not rapid. Its low content in tannin, not better than 8 per cent. on the average, is very much against what would otherwise be a valuable tanstuff.

The discovery of Karunda has allowed us to drop Mahurain from the mixtures of Central Indian tanstuffs to produce half-tan leather, but we regard it as put aside only for the time.

PYINGADU.

Xylia dolabriformis. Pyingadu. ("Ironwood of Burma.")

The bark of this tree is important as a tanstuff, as being a bark that is available in large quantities from yearly fellings both in Burma and in South India. Our analysis of the old bark, 7 per cent. tannin, was lower than the young bark, $14\frac{1}{2}$ per cent. tannin, but the suggestion is made by Captain Guthrie that the timber in

PYINGADU—*contd.*

the former case may have been floated, with the resultant loss of some of the tannin of the bark. We are anxious to examine the wood, which though too low in tannin, to be used direct as a tanstuff, has been reported to contain a low ratio of non-tannin : tannin, and to yield a 60 per cent. tannin extract, having much the properties of the well-known Quebracho extract of South America.

Tannage.

We have made one leather test. The resultant leather was terra-cotta in colour, with a very smooth grain, fibre rather short, and there were signs of crack. Thus, Pyingadu is likely to be used in admixture with other tanstuffs rather than alone.

XLVIII.—HAMAMELIDACEÆ.

PIPLI.

Bucklandia populnea.

This tree is being so largely planted in the Darjeeling district that its bark with over $10\frac{1}{2}$ per cent. tannin may later on become of interest if much of the Pipli timber is felled. The colour is very promising.

XLIX.—RHIZOPHORACEÆ.

MANGROVES.

The term "Mangrove" is applied to a number of trees not all of the same family, which grow in the ooze alongside the rivers and in the swamps of tropical coasts. This ooze is generally submerged each tide to the depth of several feet and most of the mangroves build up a network of roots which raises the mainstem almost, if not entirely, above high-water level. The trees grow in salt, brackish water, although some species are found where the water is almost sweet. Speaking generally, the barks of all mangroves contain more or less chlorides from the salt water. These chlorides are often found most largely on the surface of the bark owing to spurting

MANGROVES—*contd.*

and evaporation of salt water, but there is generally also a considerable proportion disseminated throughout the bark forming a definite constituent thereof.

1. *Goran.*

The commonest mangrove in the Sunderbans is *Goran* (indiscriminately *Ceriops candolleana* and *C. roxburghiana*). The bark is well-known to possess the objectionable feature, from a tanning standpoint, of a very red colour, but it justly forms the basis of a dye prepared both for dyeing and preservative purposes, as applied to fishing nets, sail cloths, etc. Very large quantities of *Goran* are brought into Calcutta as firewood. The bark is removed there and sold at 8 annas per maund. It is usually wet and salty. It has been tried at Maihar in admixture with Dhawa and Aoula twig bark, but hides tanned with mixtures containing as little as 15 per cent. of *Goran* develop a crack in the grain. We have, however, the evidence of one hide, tanned at Maihar in pure *Goran*, with the utmost care and "individual attention," which produced a fine leather that did *not* crack. We therefore hand over this tanstuff to the researchers of the Bengal Research Tannery, to whom we may pass on the one established fact, that admixture with Dhawa leaves of an equal weight kills the objectionable "red." They will find that the bark varies considerably in tannin content, but one of us has in the past analysed samples in Borneo of this species containing over 50 per cent tannin.

2. *Payon* (pronounced as Pé Yôn) (Malay "Bakau.")

This is very abundant in Burma and Borneo and is largely used in the manufacture of tannin extracts in the latter country. From a recent visit to Messrs. Graham & Co., Calcutta, we learn that this firm has been recommended the use of Payon by friends in Burma. It may contain up to 40 per cent. of tannin, and is less red than *Goran*, though alone it produces a brick-red, harsh leather.

3. *Rhizophora mucronata*. (Pyn.)

The commonest mangrove in Burma and generally known in most countries as the "common mangrove." This mangrove known in Malaya as "Bewis" or "Buis," yields a similar tannin extract to Payon, but somewhat darker in colour.

MANGROVES—contd.

4. *Rhizophora conjugata*.

This is very similar to *R. mucronata*.

5. *Bruguiera caryophylloides*.

Bruguieras yields similar extracts to the Rhizoporæ, but not quite so rich in tannin.

6. *Heritiera fomes*. Sundri.

This grows in the less salty upper waters of creeks; a fine timber tree, bark said to contain up to 14 per cent. of tannin, but our results here are much short of this; see page 119 of this Bulletin.

7. *Carapa obovata*. (Pinlé On : Burma.)

Has shewn nearly 50 per cent. of tannin in the bark. Gives a pink quebracho-like leather.

8. *Avicennia officinalis*, the White Mangrove.

Very extensive in South-East India, has a white colour; but unfortunately is very low in tannin. Contains considerable non-tannin astringent matter. A tanning test with this bark produced a very tough leather, reddish-brown in colour, but the crack on the grain was serious.

9. *Sonneratia apetala*.—*S. Acida*.

Both these species are common in Burma and are to be found in South India. Our sample of the former was low in tannin, but the leaves are interesting in containing as much as 8.5 per cent. tannin inasmuch as a rule, the leaves of the so-called mangroves contain little or no tannin.

L.—COMBRETACEÆ.

DHAWA.

Anogeissus latifolia. Wall. (Dhawa; Dhaura, Vellay Naga, Tam).

Hooper says :—

“A specimen of the bark from Madras yielded as much as 32.5 per cent. of tannin. The leaves are used in Bombay and the North-Western Provinces for tanning, and Dr. Lyon found them to contain as much tannin as the Sumac. Professor Hummel examined a sample of these leaves from

DHAWA—contd.

Ajmer and found 15·5 per cent. of tannin. The sale of the dry and powdered leaves has been suggested. Experimental extracts of the leaves have not been very satisfactory preparations on account of the insoluble matter and the absence of brittleness in the finished product."

Very many samples of the leaves were examined in the Dehra Dun Laboratory in years prior to 1914, with results that varied so much that the conclusion was reached that a reliable product could not be produced on the large scale. Probably the samples were taken without a full study of the tree and climate.

A mixture of old and new leaves and sticks has long been used by Messrs. Cooper Allen & Co., under the name of "Country Sumac."

The Esociet Company then undertook a very careful study of the tree, which is very widely spread in the Central parts of India. It was found that the twig bark contained about 15 per cent. tannin, while the bark of the bole usually contained below 10 per cent. The mature leaves, taken immediately after the rains, carry 16 per cent. tannin, if prepared properly, without sticks or sand. The young leaves appear in April in Central India in great profusion. The extreme tips of the leaves on these first shoots, which are usually reddish in colour, carry up to 55 per cent. of tannin. We regard it as impracticable to collect this product on the large scale, unless certain areas could be worked as plantations with skilled labour and good supervision. It is possible, however, to wait until the larger leaves of the shoots are $1\frac{1}{2}$ inches in length, when the whole of the leaves and the petioles can be collected very cheaply, to yield a product carrying at least 26 per cent. tannin.

Mr. Lushington, Conservator of Forests, Madras, has found it practicable to collect the red tips (which are found in greater abundance in the South) to yield a product which he has named "Rosy Sumac," a sample of which shewed $54\frac{1}{2}$ per cent. tannin, with only $14\frac{1}{2}$ per cent. non-tannin. We have been glad to hear that operations have been commenced to exploit this tanstuff in Madras.

After four years of working this tree on the large scale (over 50,000 maunds) we have developed three separate commercial products:—

- (a) *Dhawa twig bark*.—If the trees are pollarded in January—February in Central India, the whole of the twig bark

DHAWA—*contd.*

can be stripped from the cut branches to yield a 15 per cent. tanning bark, which when applied in mixture with Turwad gives excellent results. With this bark in mixture with Dhawa leaves, Mahurain and Aonla twig bark, we produced the first-acceptable imitation- "half-tan" leather—Refer Section B of the Director's First Annual Report to March 1918 for method of preparation of twig barks.

- (b) *Dhawa Sumac*. ("Noti").—The pollarded trees send forth a tremendous crop of young red and green shoots at the end of March. If these shoots be taken then, another crop will be ready to be taken at the end of April, the trees again yielding a crop at the end of May. It is definitely proven that such plucking does not injure the tree. The mixture of red leaves, green leaves and petioles is dried quickly in the sun. It is made into a heap on a carpet of gunny bags and thoroughly beaten with bamboos, with intermittent sieving through a 10 mesh sieve. It is not advisable to carry this beating too far. The product dries to a pale green colour and looks and smells exactly like coarse Italian Sumac. If this work is carried out properly, the resultant tanstuff carries 30 per cent. tannin and 16 per cent. non-tannin. If the operations are not carried out as described; if too much of the larger petioles is beaten through the sieve; if any sand is allowed to be mixed in; if rain or dew falls upon the product; the result is a lower percentage of tannin. When one considers the expensive methods applied to the collection of Italian Sumac (to plant, to wait three years, with cultivation of the soil, to collect and dry the leaves and then mill in stone mills to produce a product carrying 24 per cent. to 28 per cent. tannin), it will be seen that Indian Sumac will be able to meet other Sumacs in the market of the world. This prepared Sumac can be produced at a cost of Rs. 1-4 per maund "under the tree."

Qualitative tests of the leaves of Dhawa all indicate that the tannin is more of the pyrogallol than catechol class and answers to the reactions of common Sicilian Sumac.

DHAWA—*contd.*

(c) *Dhawa leaves*.—The trees should be left alone during the rains and directly the rains cease, a very large harvest of large and small leaves can be taken. This product should be dried, beaten and then winnowed down the wind. It should be beaten repeatedly with alternate dryings, until each leaf is broken into three pieces at least. When clean, without sticks or sand, this product will shew a steady 16 per cent. tannin on the large scale. It can be produced in unlimited quantities at 12 annas per maund "under the tree." This is the right product for tanneries in India.

After the rains-leaves are taken, the tree clothes itself with leaves again in November:

Tannage.

The *chamar* of the Central parts of India has long used a mixture of young leaves, old leaves, and sticks, which he breaks up and mixes with water to form a "porridge" in which to tan his leather. He regards this product, which he calls "Noti," as the quickest tanning agent in these parts. Until we gained actual practical experience with Turwad bark, we regarded Dhawa as very quick in penetration. We now know Turwad to be quicker than Dhawa. Alone, "Noti" produces a pale coloured leather with a tinge of green. The smallest addition of a bark with a red influence (Turwad, Kahua, Goran or Aonla), entirely overcomes the green colour, to produce almost any shade of cream or fawn; equally with any bark that produces a red leather, a small addition of Dhawa Sumac will bleach the leather most satisfactorily. Dhawa alone does not keep the hide properly swollen during tanning, but we have been able to overcome this by admixture of Mahurain, and lately, most satisfactorily with Karunda. The tannin of Dhawa is quickly soluble in cold water. In our opinion, Dhawa should never be extracted hot. We have been able to produce a satisfactory solid extract from the leaves and the bark mixed, quite brittle and easily soluble, the only thing being that owing to the large amount of non-tans, we do not think it possible to make a solid extract that will be richer than 50 per cent. Everything points to the production of Dhawa Sumac in the future, with between 30 per cent. and 40 per cent. tannin, which will pay better to export from India than a solid extract. The Esociet Company

DHAWA—*contd.*

have been able to export four lots of 20 tons each to England and to South Africa, for which the tanner has had to pay at the rate of four to seven annas per unit of tannin per maund, in spite of which he has sent repeat orders. We have lately sent big consignments to Madras, but there is so much Dhawa available, that Bombay, Madras and Calcutta should be able to produce their own stuff from local jungles.

Dhawa as a Dye.—It is not yet very generally known that the leaves of the *Anogeissus latifolia* constitute a valuable mordant dye stuff. Dhawa leaves and seeds have been used as a dye, or more strictly speaking, as a *stain* in India for very long, but the proper development of an insoluble colour pigment within the textile fibres by means of a suitable mordant has apparently not been studied hitherto. A series of dyeings have been made at Maihar on wool, with varying mordants and in varying proportions and series of shades obtained from bright yellow to full brown. The shades can be modified by the addition of small quantities of our direct lac-red paste, and Dhawa may also be suggested for the modification (yellowing) of Cutch browns dyed with *Acacia catechu*—Cutch—to produce “Khaki” shades. The application of Dhawa to cotton is more complicated and not recommended here.

YON.

Anogeissus acuminata.—The success with which our Central India *Anogeissus* had been applied, induced Mr. Pilgrim to look for this species in Burma and analysis results of the *Acuminata* indicate that its products will afford a fine tanstuff for Burma.

The young leaves recently collected have shewn as much as 32 per cent. tannin, but they very soon mature to a 17 per cent. and finally to a 10 per cent. leaf.

DHO.

Anogeissus pendula.—Both leaves and bark are similar to Dhawa, both in the way that young leaves are richer than the old leaves, and that the twig bark is richer than that from the bole.

DHO—*contd.**Tannage.*

We have little experience, but that not unfavourable of the products from Dho in the tanpit. There are very large areas near Jhansi of almost pure Dho forests and should tanneries be started in Bundelkhand, there is no doubt that this tree will afford a cheap tanning agent.

KAHUA.

Terminalia arjuna.—Bedd. (Kahua; Koha; Arjuna).

“Bark astringent, occasionally used for dyeing and tanning”—
HOOPER.

The Hon'ble Mr. C. E. Low tells how this bark is regularly used by *chamars* in the Central Provinces.

The bark was first introduced to the tanneries of Cawnpore in 1915 by the Esociet Company. It is now so firmly established as a tanstuff that over 50,000 maunds have been sold this year in addition to an equal amount during the previous three years.

This, usually fine, large tree is found along streams in the Central parts of India. It is valued for its shade, retention of banks, and its timber (which is likely to be more appreciated later).

The bark is exceptionally thick, very damp, soft and red inside, with a grey surface, very free from fibre.

Every hot weather, this bark sheds thick flakes, which fall to the ground (these contain 5 per cent. tannin). It was after a study of this phenomenon that Mr. Fraymouth worked out a method of taking off the outside layers of the bark, taking care not to expose the cambium layer. In every case, he found that the bark grew again from below, the exposed layer falling off and after two years' rest, the original thickness of the bark was found. Many thousands of the trees so treated in 1915 are now yielding a fresh harvest of bark, and in not a single case has any damage been done to the trees, except where almost the whole of the bark has been chopped away with an axe, exposing the cambium layer and the wood.

KAHUA—*contd.*

If the FRAYMOUTH CUTTER as illustrated is applied with a hammer blow to the bole of the tree (leaving young trees alone), the cutter blade enters, turns and chips out a small piece of bark. It is almost impossible to expose the cambium layer with this cutter. The chips when dried are small, 2"×1", and are convenient for packing into bags. It is of the utmost importance that axes should not be used, and we have proven that it is possible to entirely prevent the appearance of pieces of white cambium layer on the chips of the bark. The tanneries can help greatly by refusal to accept bark which shews the white layer.

The average stuff delivered at the tannery carries over 20 per cent. tannin. The bark of the bole shews 20 per cent. to 24 per cent. tannin, lower branches carry 18 per cent. smaller branches less tannin, while the leaves carry no tannin.

The tannin principle behaves towards re-agents similarly to English oak bark, that is to say, it gives some of the reactions for pyrogallol and some for catechol tannins.

The fruit.

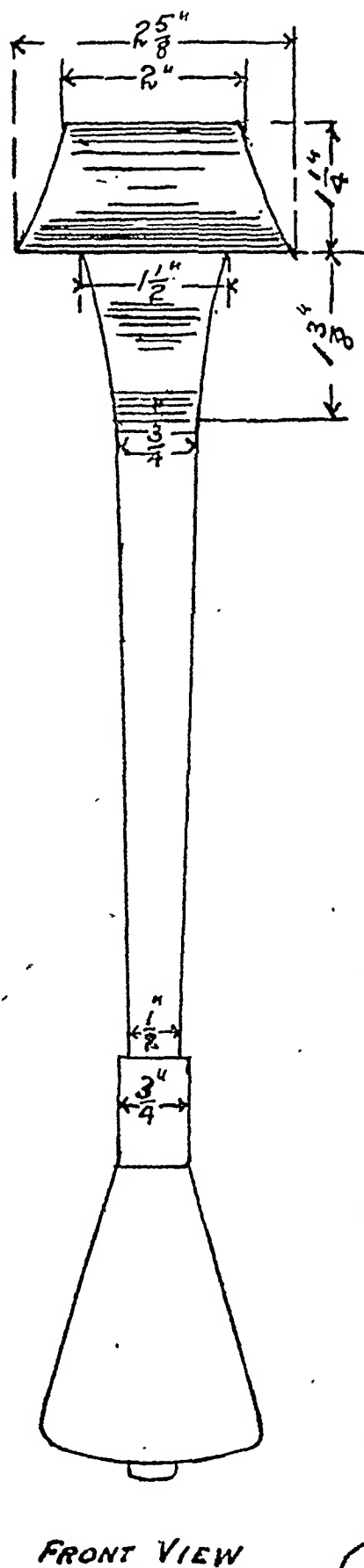
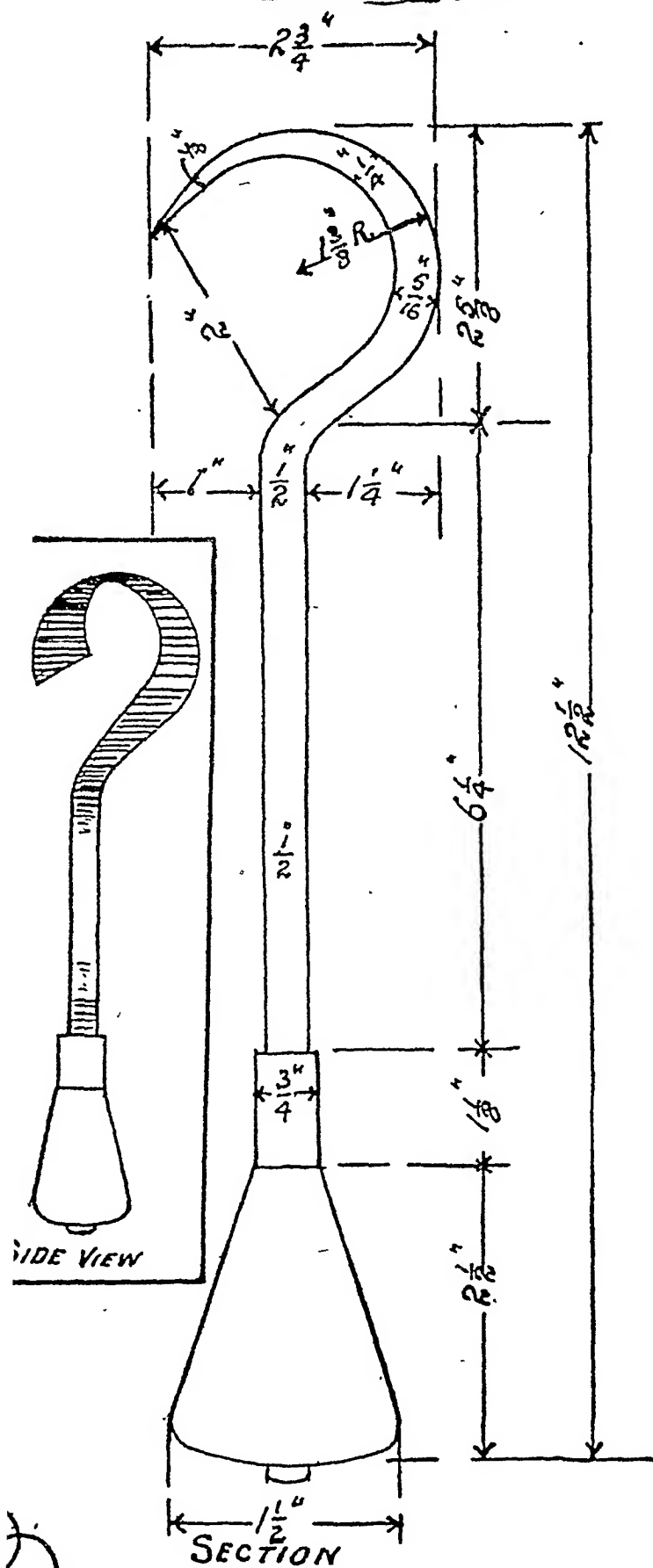
The trees produce a prolific crop of winged fruit of the size of a myrabilan. We have made persistent efforts to utilise these without success. When green and nearly full grown in July, the tannin content is 20 per cent. with an equal quantity of non-tannin. Later when full-grown, and when they fall from the tree, the tannin is reduced to 7 per cent.

Tannage.

In Kahua bark, we have discovered a tanning agent, which in its all-round application is and will be of immense value to the tanner in India. With Kahua alone, the colour of the leather is a light brown with no excessive red tint. The grain is left in a smooth condition, and while with fully limed hides, a fine upper leather (full tan) can be produced of great suppleness and softness in texture, after short liming and long tanning in the way English oak bark leather used to be made, a very fine sole leather can be produced. Kahua liquors give no trouble in the tannery; a certain iridescence noticeable at times does no harm. The addition of 25 per cent. of Dhawa leaves to 75 per cent. of Kahua bark produces a perfect

KANWA BARK CUTTER

—SCALE $\frac{1}{2}$ SIZE—



KAHUA—*contd.*

light-fawn colour on leather, which is ideal for fine harness work, etc.

The fruit does not produce a good leather.

BAHERA.

Terminalia belerica.

The fruit of this tree, Beleric Myrabolans, was exported from India in fairly large quantities before the war. While Hooper writes of results varying from 5 per cent. to 17 per cent. tannin, we have found that the flesh of the full-grown, but not over-ripe fruit carries 25½ per cent. tannin, while the stones carry 14½ per cent.

The crushed and dried fruit can be prepared for 6 annas per maund "under the tree" and thus constitutes a very cheap source of tannin.

Tannage.

We have used the fruit as a final bath for half-tan leather with success. It induces the same "bleach" as true Myrabolans. Used alone it tans a much plumper and a softer leather than ordinary Chebulic Myrabolans. We suggest that the large quantities that were exported were probably used in mixture with crushed Myrabolans. We think that Indian tanners should make trials of this cheaper product in mixture with the more expensive Myrabolans. More work must be done on this tanstuff.

MYRABOLANS.

Terminalia chebula.—(The common Myrabolans.) (Hirda, Harra, Kadukai, etc.)

Hooper wrote:—

"The fruits of this tree well known as Chebulic Myrabolans, are a valuable tannin agent. The tree is widely distributed in India, and the fruits are collected largely by the Forest Department and exported to Europe."

"The dried fruits known as *hurras* or *hurdas* are extremely rich in gallo-tannic acid and require no preparation except powdering or crushing in a mill. Some recent (1900)

MYRABOLANS—*contd.*

analyses by Dr. Leather of samples obtained from different provinces of India fairly indicate their composition:—

	Extract.	Tannin.
Madras	57·87	38·67
Bombay	59·47	40·80
North Western Provinces	59·47	43·74
Central Provinces . . . . .	...	31·00

The fruits should be collected before maturity, otherwise there is apt to be a variation in their strength. Dr. B. H. Paul, for instance, examined indiscriminately three samples submitted to him at the Indian and Colonial Exhibition in 1886, and he obtained 32·8, 26·8 and 6·1 per cent. of tannin. The astringent principle resides in the outer pulp of the fruit; the stone-like kernel containing hardly any;"

Since this was written, the export of Myrabolans has greatly increased, and there is scarcely a tannery in any part of the world that does not use this Indian tanstuff, chrome tanneries naturally excepted. The British tanner having been swindled by those who mixed in sand and adulterants in crushed Myrabolans, insists upon getting the uncrushed fruit, and he believes that the all-yellow fruit is better than those which are dark in colour. We have investigated this point and can positively say that, so long as the fruits are sound that colour has no influence on the tannin content. We do not believe that the shape of the fruit bears any influence on its tannin value.

The ordinary commercial product, "*jungle hurra*," of the Central parts of India averages about 28 per cent. of tannin. If rotted fruits are removed, the average rises to 34 per cent. If when the fruit falls, or is beaten down from the tree, each fruit is broken and stones removed, the clean dry flesh will carry as much as 52 per cent. tannin. The bulk of useful product is thus reduced to one quarter, while the weight is reduced to 40 per cent. of what is usually carted and moved by rail.

Now, while this concentrate at over 50 per cent. can be made at a cost of a few annas per maund, the best solid extract of Myrabolans that we have heard of, was not much richer than 60 per cent. and the usual solid or semi-solid extract in the market shews 58 per cent. to 60 per cent. Thus, it is clear that to extract and solidify the tannin

MYRABOLANS—*contd.*

of Myrabolans at a cost of several rupees per maund is wrong. The "clean flesh" should be the form in which India should export Myrabolans.

These facts were known to many Continental tanners before the war, and large quantities of destoned, crushed Myrabolans were prepared up-country and shipped to Continental ports. Lately, as sea freight conditions have become worse and worse, relatively larger quantities of *crushed* Myrabolans are being shipped. Unfortunately, none of those ordinarily concerned in this business will prepare really clean, stone-free, dust-free Myrabolans flesh, which is the most perfect product. In our opinion, Indian tanneries would find great saving if they would use only the clean product, and if this practice becomes general, the saving in rail-wagon space would be enormous. Under the circumstances that Myrabolans shipments are granted priority both for steamer space and finance, we are of opinion that only Myrabolans flesh without stones should be shipped at present.

During the operation of crushing and destoning Myrabolans, the Esociet Company produces a reject, a mixture of stones, dust, partly rotted fruit, etc. We have made an experiment by treating this by gas agitation extraction to produce a liquor which when solidified was of fine colour, brittle, and shewed on analysis:—

	Per cent.
Tannin	38.70
Non-tannin	42.30
Insolubles	5.25
Moisture	13.75
	<hr/> 100.00

The quantity of fruits produced by the trees varies enormously in different years. In one particular tract the outputs for the last three years have been 300 maunds, 400 maunds and 3,000 maunds, respectively. These conditions coupled with the pernicious "contract" system, lead to excessive gambling in the business of Myrabolans collection, spoiling of many trees in bad years and loss of this valuable product in abundant years. By far the greater part of the Myrabolans of India comes from privately-owned forests. Practically no re-planting of the tree is being done. The attention of forest owners is drawn to this very necessary step, if India is to retain a most valuable trade in an essential tanstuff.

MYRABOLANS—*contd.**Tannage.*

Myrabolans are very largely used in admixture with Babul bark in the press leaches of Cawnpore.

The Turwad tanner of the South always uses Myrabolans, which have been boiled in water, in which brew (when cold) he packs his half-tan hides for two to three days at the end of the process. This strong liquor fills up the pores of the lightly-tanned Turwad leather and at the same time, corrects the colour to a very perfect white, which lasts until the leathers have been exposed to strong light.

LIII—LYTHRACEÆ.

SEJA.

Lagerstrœmia parviflora.—Seja.

During our search for very widely distributed species, the Silvi-culturist to Government, Mr. Marsden, suggested the twig bark of Seja, and experiments were made in the collection of this bark and in its application to leather making. The results of these experiments went to shew that Seja is never richer than 10 per cent. tannin, and unfortunately the bark when stripped resists all efforts to break it up into a form in which it can be packed closely. We have, therefore, with regret, put this tanstuff on one side for the present.

Tannage.

Seja tans a light-weighing leather with a good colour (light fawn), but its influence is very noticeable on the grain, which has a pebbled appearance. It is most likely that there will be, in the future, tanneries which are so situated near to Seja forests, that they will find it a profitable business to collect the twig bark and bring it short distances by cart, to be of great use in the tannery. We do not think that it will ever be carried successfully by rail.

LXXIII—APOCYNACEÆ.

KARUNDA.

Carissa carandas.—Is mentioned by Watt and Hooper as bearing fruits and leaves that are used in dyeing and tanning. We have

KARUNDA—*contd.*

found that the leaves of the cultivated Karunda are very poor in tannin and are of no value in this direction.

Carissa spinarum.—Karunda.

We claim this is an original discovery as a tanstuff. Very large areas throughout the Central and Northern parts of India are covered by this bush. We were led to examine the leaves by the fact that the bush is the most widely spread that we know of. The suggestion was made by Mr. R. G. Marriott. The mature leaves carry 11 per cent. tannin and 24 per cent. non-tannin. The quite young leaves carry no tannin. In many parts the bush grows fresh leaves before the old ones fall, and as the bush coppices well, we find it possible to collect the leaves all the year round. In parts of the United Provinces, frost turns the leaves brown and thus reduces the tannin by 2 per cent. or so. The bark carries only 5 per cent. to 8 per cent. tannin.

The branches of the bush are chopped off, and are allowed to dry quickly in the sun. The branches are beaten on a clean place so that all the dry leaves fall off. The leaves are made into a heap on a carpet of gunny bags, and are beaten and dried alternately with sieving through a $\frac{1}{8}$ th inch sieve. We make our Karunda sieves by knocking holes with a wire nail in an opened-out kerosine tin. All the thorns and fruits remain on the sieve and may be thrown away. The powdered leaves which pass the sieve should be pale green in colour and should contain no stick, sand or fruit or thorns.

The cost of this product is 14 annas per maund "under the tree."

Tannage.

The infusion is very pale in colour. When applied alone, Karunda leaves cause extreme swelling of the hide and if care is not taken, "drawing" of the grain appears. This can be entirely avoided by the use of Gothar in mixture. Karunda solutions deposit a pale-green "bloom" which is easily removed by rubbing. Aonla twig bark affords an ideal ingredient in mixture with Karunda, for the red effect of the former blots out the green effect in Karunda, while karunda keeps the hide swollen.

KARUNDA—concl'd.

Karunda solutions do not tan quickly, there is only 11 per cent. of tannin present, but the 24 per cent. of non-tans will find great appreciation. The mixture—

	per cent.
Aonla	70
Karunda	30

works out to a tanstuff carrying 20 per cent. tannin costing only Rs. 1-4-0 "under the tree."

Karunda works well with Babul, Sal, Kahua and such of the Mangroves as we have tried. A small proportion of Dhawa with these makes for an excellent colour.

Karunda leather is remarkably free from crack and shews less tear and longer fibre than any leather yet produced in Maihar.

Karunda leaves used in direct contact with the hide if used too long without renewal, will sometime cause discoloration of the hide in the pit.

The mixture—

	per cent.
Aonla twig bark	50
Kahua	10
Karunda	20
Dhawa Sumac	20

after early treatment with Gothar, is regularly used at Maihar to produce excellent leather.

The actual cost of this mixture from local areas is less than Rs. 1-4-0 per maund into tannery, and it carries a full 20 per cent. tannin.

XCVIII.—EUPHORBIACEÆ.

AONLA.

Phyllanthus emblica: Linn. (Aonla; Amla).

(NOTE.—This should not be confused with *Avla*, another name for Turwad.)

Hooper wrote:—

"The fruit of this small tree is well-known as the Emblic Myrobalan, and has acid and astringent properties which are

AONLA—*contd.*

utilised either alone or in conjunction with other substances. The dried pulpy portion of the immature fruit affords as much as 35 per cent. of tannic acid, but in a ripe state only traces of the principle are found. There is abundance of soluble non-tannin present, but there is much less colouring matter than in the bark."

"The leaves of the plant are regarded as one of the best tans by the Bengal *chamars*. Professor Hummel reports an estimation of 18 per cent. of tannic acid in the leaves. The decoction was pale yellow coloured and slightly turbid. They appear to contain some essential oil or fat. The leaves carefully dried and possibly ground, might find a ready sale The bark is used for tanning in Travancore."

This tree presents a most striking result of the application of our principles to search for the "seat of tannin" through those parts of a tree, which, when taken, will grow again. While the bark of the bole was known to the tanners, its average value rarely exceeds 8 per cent. to 9 per cent. tannin and the poor quality of leather that it will produce had prevented any large use. During our study of the tree, we found that if the branches (up to 2" diameter at butt) are lopped off, the bark may be stripped by beating, and that the small curled pieces of twig bark so obtained afford a very perfect tanstuff. We can say that up to the present, we have found no better *all-round* tanstuff during our research. The pollarded tree will produce long healthy shoots within two years' time which may be taken again.

Aonla twig bark.

Many analyses have shewn that a full 24 per cent. tannin with some 17 per cent. non-tannin may be expected when this bark is properly collected on a commercial scale, and that it can be got and delivered to the tanneries at well under Rs. 2 per maund. Refer Section B of the Director's First Annual Report to end of March 1918 for description of method of stripping of twig barks.

Alone, Aonla twig bark tans a leather with a reddish colour. The grain remains very smooth and well-swollen during tanning. If to two-thirds of Aonla bark, one-third of Karunda is added, the mixture produces a fine crust leather with a pale-cream colour.

The cost of this product "under the tree" is Rs. 1-4 per maund.

AONLA—*contd.**Aonla leaves.*

Every sample that we have examined of the young leaves has shewn great richness in tannin, from 23 per cent. to 28 per cent. These leaves are very easily and cheaply collected, and because of their small size, need not be crushed further before despatch, so long as all twigs, etc., are sieved off.

The cost of these prepared leaves should not exceed Re. 1 per maund "under the tree."

Aonla fruit. Emblic Myrabolan.

These were formerly sent Home from India in very large quantities. This export has stopped because of careless collection of the product. When picked properly of a full size and yet un-ripe, in November and December, and if the flesh be beaten off the stone at once, to be dried *quite white*, it is possible to prepare a commercial product with 35 per cent. tannin.

During the last two years, many of those who know India's forests well, have suggested that, owing to the sporadic way in which Aonla occurs, it would be impossible to collect very large quantities of tanstuffs from this tree. The results of large scale collection by Esociet Company during the last season conclusively prove that at least 2,000 maunds of twig bark can be got at each collecting centre. At first we thought that the cost of collection of the twig bark would be too high, but the steady high values (24 per cent. tannin) and the fine results in the tan-pit have shewn us that the bark is worth the price that induces collectors to get it with enthusiasm.

Tannage.

Aonla twig bark produces a very smooth grain on the leather with a steady swelling of the hide during tanning. Alone, the leather tends to shew a red colour, but the addition of a little Dhawa Sumac or leaves and a little of Karunda entirely eliminates the red colour.

Alone, Aonla twig bark being very similar in appearance to Turwad bark, the pieces being three inches in length, is much the best diluent to use with the expensive Turwad bark. As it is richer in tannin than Turwad, less of Aonla is required (per lb. of leather) than of Turwad. As its cost is now less than one-third of that of Turwad, and as it will always be cheaper, and as it can be worked

AONLA—*concl'd.*

by the Turwad tanner by his own Turwad methods, we claim that we have discovered a way of greatly reducing the cost of half-tan leather. Further, Turwad alone tends to produce a red effect in leather; our application of Dhawa and Karunda (greens) to counteract reds has afforded a method which will be of extensive commercial value to India.

While we have been conducting experiments at Maihar with Turwad-Aonla-Karunda mixtures (worked as in Turwad tanning) the Bombay tanneries are feeling their way with a mixture:—

Turwad	65
Aonla	25 costing 5-17 as. per unit.
Karunda	10
	<hr/>
	100

Experiments ahead of this at Maihar with a mixture—

Turwad	50
Aonla	33 costing 4-35 as. per unit.
Karunda	17
	<hr/>
	100

have produced a leather that cannot be told from Turwad leather.

We are convinced that a leather with all the characteristics of Turwad can be produced with:—

Turwad	15
Aonla	40 costing 2-4 as. per unit.
Karunda	25
Dhawa	20
	<hr/>
	100

using 5 per cent. out of the 15 per cent. Turwad as a finishing bath.

Compare with the above: Turwad now at 7 annas per unit and 3 annas per unit in peace time!

CVII.—FAGACEÆ.

OAKS.

Q. Pachyphylla;—*fenestrata*;—*lineata*.

We had hoped that by this time it would have been possible to have added some data relating to the practical application of the.

OAKS—*contd.*

above, to the preliminary analytical work already carried out, but the bulk samples have come to hand too late for this report.

As in all our work, we feel that a thorough investigation involves not the mere analysis of one small sample, but that of a number of samples taken from different parts of the tree, from different trees in the same area, and both of these at different times of the year, so that it will obviously take a long time to complete even our analysis work on the Oaks and Chestnuts. The results, however, of first analyses are interesting.

The outstanding analysis is that of the mature bark of *Quercus fenestrata* (16 per cent.) which also has a remarkably fine light colour; but unfortunately, we are unable, up to now, to obtain figures of the distribution of this species.

Messrs. Cooper Allen & Co., Ltd., Cawnpore, arranged some time ago to try the *Quercus pachyphylla* (Sungre Katus) valonea in bulk.

Commenting on the analyses (p. 162) it should be mentioned that the ratio of non-tannin over tannin in the case of *Quercus fenestrata* is almost 1 : 2, which taken in conjunction with the absence of colour, would indicate this as the most likely material of those analysed, for future experiments in the manufacture of extracts. The best average that is claimed for English oaks is from 12 per cent. to 14 per cent. tannin. It will be noted that the twig bark of *Quercus fenestrata* is of comparatively little value ($9\frac{1}{2}$ per cent.), whereas in the case of *Q. pachyphylla* ($12\frac{3}{4}$ per cent.), and *Q. lineata* ($10\frac{1}{2}$ per cent.), this twig-bark is somewhat better than the mature bark ($12\frac{1}{4}$ per cent. and $9\frac{3}{4}$ per cent.). It is further worth noting that the mature leaves of certain of these oaks (*Q. pachyphylla* and *Q. lineata*) run quite high enough in tannin (above 10 per cent.) to justify practical tanning experiments in this direction.

CHESTNUTS.

Castanopsis hystrix; *C. tribuloides*; *C. Indica*.

The mature bark of *Castanopsis hystrix*, and the twig bark of *C. tribuloides*, both give promising analysis results (13 per cent.). It is a coincidence to be noted that our samples of both leaves and twig bark of *C. hystrix* happened to show exactly the same tannin content. We would call attention to the fact that the *C. tribuloides*

CHESTNUTS—*contd.*

and *C. Indica* both grow on relatively low ground :—for instance in the Tista valley at about 500 feet, these species are plentiful, and we understand that at least one of them extends into the plains of Bengal.

In regard to both oaks and chestnuts, careful practical comparisons will have to be made of the difference in tannin between twig barks and mature barks. The woods also will be analysed and studied with a view to the possibility of their application in the manufacture of oak-wood and chestnut-wood extracts.

During the study of these hill tanstuffs, we are bearing in mind that the cost of transport to the rail heads in the plains will probably not be less than Re. 1 per maund, which will have to be added to the cost of collection.

If the hill railways can be persuaded to give really low rates under the circumstances that most of their goods traffic is upwards, there are great possibilities in tanstuff collection as a hill forest industry.

CHAPTER XIV.

CHEMICAL ANALYSIS OF INDIAN TANSTUFFS,

BY J. A. PILGRIM.

III.—MAGNOLIACEÆ.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.12th March,
1918.*Michelia excelsa*—

Tannin absorbed by Chromed			
Hide Powder	.	.	6.57
Soluble non-tannins	.	.	12.28
Insoluble matter	.	.	81.15
TOTAL			100.00

Ratio. Non-tannin : Tannin=1.9 : 1.

Colour analysis calculated to a standard
strength of 0.5% Tannin :—

Red	.	:	8.3
Yellow	.	.	13.3

XIII.—TAMARICACEÆ.

JHAO.

23rd August,
1917.*Tamarix dioica*—Bark of young twigs
from Mandla District, Hamirpur :—

Tannin absorbed by Chromed			
Hide Powder	.	.	10.16
Soluble non-tannins	.	.	9.98
Insoluble matter	.	.	79.86
TOTAL			100.00

Non-tannin : Tannin=1 : 1.

XVI.—TERNSTROEMIACEÆ.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

TEA.

31st October, 1917. *Tea (Camellia thea)* 'fluff' from E. J. Oakley, Esq., of Messrs. Kilburn & Co., Calcutta :—

Tannin absorbed by Chromed	
Hide Powder	8.38
Soluble non-tannins	10.71
Insoluble matter	80.91
TOTAL	100.00

Non-tannin : Tannin=1.3 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red	26.3
Yellow	73.7

XVII.—DIPTEROCARPACEÆ.

SAL.

Sal (Shorea robusta).

5th May, 1917. I. *Leaves and Twigs* from Kheri—April 1917—

	(a) Cold Extraction.	(b) On sub- sequent applica- tion of heat.
Tannin absorbed by Chromed		
Hide Powder	10.56	12.28
Soluble non-tannins	22.77	11.81
Insoluble matter	66.67	75.91
	100.00	100.00
		Total of (a)+(b).
Tannin		22.84
Non-tannins		34.58
Insolubles		42.58
TOTAL		100.00

Non-tannin : Tannin=1.5 : 1.

Sal (old leaves) . . . .	...	8.76%
Sal (young leaves) . . . .	...	20.50%

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

SAL—*contd.*

5th February, 1918. II. Young Sal leaves, discoloured, average sample from 65 maunds, milled at Maihar :—

Tannin absorbed by Chromed			
Hide Powder . . .			19.85
Soluble non-tannins . . .			18.90
Insoluble matter . . .			61.25
TOTAL .			100.00

Non-tannin : Tannin = 1 : 1.05 or practically 1 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	8.9
Yellow . . .	27.5

20th February, 1918. III. Sal leaves, young and old mixed, after frost had turned them brown ; —from D. F. O., South Kheri Division. Average of 1 maund 30 seers :—

Tannin absorbed by Chromed			
Hide Powder . . .			7.64
Soluble non-tannins . . .			16.37
Insoluble matter . . .			75.99
TOTAL .			100.00

Non-tannin : Tannin = 2.1 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	10.7
Yellow . . .	32.1

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

SAL—*contd.*

20th February, 1918. IV. Sal leaves, young and old—green leaves taken from whole shoots before frost, from South Kheri Division—average sample from 2 maunds 10 seers :—

Tannin absorbed by Chromed			
Hide Powder . . .	8.28		9.60%
Soluble non-tannins . . .	17.25		
Insoluble matter . . .	74.47		
TOTAL . . .		100.00	

Non-tannin : Tannin = 2 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	6.5
Yellow . . .	26.0

22nd February, 1918. V. Sal leaves—upper fine dried leaves on shoots, taken after frost ;—average sample from 2 maunds 10 seers :—

Tannin absorbed by Chromed			
Hide Powder . . .	7.21		7.56%
Soluble non-tannins . . .	16.21		
Insolubles . . .	76.58		
TOTAL . . .		100.00	

Non-tannin : Tannin = 2.2 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	9.25
Yellow . . .	33.33

SAL—*contd.*

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

22nd February, 1918. VI. Sal leaves—upper fine green leaves from shoots, taken before frost ;— average sample of 1 maund 38 seers :—

Tannin absorbed by Chromed		
Hide Powder . . .	6.57	8.26%
Soluble non-tannins . . .	15.73	
Insoluble matter . . .	77.70	
TOTAL . . .	100.00	

Non-tannin : Tannin = 2.4 : 1

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	8.3
Yellow . . .	22.0

Sal Twigs

30th April, 1917. VII. Sal bark beaten out with mallets (fibrous portion) :—

Tannin absorbed by Chromed	
Hide Powder . . .	3.45
Soluble non-tannins . . .	8.08
Insoluble matter . . .	88.47
TOTAL . . .	100.00

Non-tannin : Tannin = 2.7 : 1.

Sal Bark.

30th April, 1917. VIII. Small fibres mixed with outer crust :—

Tannin absorbed by Chromed	
Hide Powder . . .	9.12
Soluble non-tannins . . .	7.66
Insoluble matter . . .	83.22
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.2.

SAL—contd.

Tannin Estima-
tion by Lead
(Pb) method
calculated to
Dry material.

Sal Bark.

30th April,
1917.

IX. *Dust* :—

Tannin absorbed by Chromed	
Hide Powder . . .	7.63
Soluble non-tannins . .	7.72
Insoluble matter : . .	84.65
TOTAL . .	100.00

Non-tannin : Tannin=1 : 1.

30th April,
1917.

X. *Sal Bark*, cut up as done by a commercial firm in 1915-16 :—

Tannin absorbed by Chromed	
Hide Powder . . .	9.31
Soluble non-tannins . .	7.47
Insoluble matter . . .	83.22
TOTAL . .	100.00

Non-tannin : Tannin=1 : 1.25.

18th July,
1917.

XI. *Sal powder* “concentrate” from Government Tannery, Allahabad :—

Tannin absorbed by Chromed	
Hide Powder . . .	12.33
Soluble non-tannins . .	8.42
Insoluble matter . . .	79.25
TOTAL . .	100.00

Non-tannin : Tannin=1 : 1.5.

18th July,
1917.

XII. *Sal fibre* freed from powder, from Government Tannery, Allahabad :—

Tannin absorbed by Chromed	
Hide Powder . . .	3.11
Soluble non-tannins . .	4.09
Insoluble matter . . .	92.80
TOTAL . .	100.00

SAL—concl'd.

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

21st October, 1917. XIII. Old Sal bark—low grade. When the powder was separated from the fibre, the result was as follows :—

	Powder "Concen- trate."	Fibre separated from dust.
Tannin absorbed by Chromed Hide Powder .	6.86	3.39
Soluble non-tannins .	7.30	4.47
Insoluble matter .	85.84	92.14
TOTAL .	100.00	100.00

Non-tannin : Tannin=1.1 : 1 and 1.3 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . .	21.36	27.3
Yellow . .	66.82	62.2
Black . .	1.36	1.27

6th December, 1917. *Hopea parviflora*, Iron Wood—from D. F. O., South Mangalore, through the Director of Industries, Madras :—

	(1) Young bark.	(2) Old bark.	
Tannin absorbed by Chromed Hide Powder .	17.06	21.71	(1) 16.47%
Soluble non-tannins .	4.60	4.69	(2) 23.99%
Insoluble matter .	78.34	73.60	
TOTAL .	100.00	100.00	

Non-tannin : Tannin=1 : 3.7 and 1 : 4.6.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . .	11.5	12.00
Yellow . .	36.0	40.0

XX.—STERCULIACEÆ.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

MANGROVES.

2nd August,
1917.

I. *Heritiera fomes*, Sundri Bark.

Sample from Government Inspector of
Hides, Bombay :—

Tannin absorbed by Chromed			
Hide Powder . . .			7.34
Soluble non-tannins . . .			4.36
Insoluble matter . . .			88.30
TOTAL . .			100.00

Non-tannin : Tannin = 1 : 1.68.

Colour analysis calculated to a
Standard of 0.5% Tannin
Strength :—

Red . . .	24
Yellow . . .	54

12th October,
1917.

II. Sundri bark from Messrs. Graham &
Co., of Calcutta :—

Tannin absorbed by Chromed			
Hide Powder . . .			7.18
Soluble non-tannins . . .			4.22
Insoluble matter . . .			88.60
TOTAL . .			100.00

Non-tannin : Tannin = 1 : 1.7.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red . . .	25
Yellow . . .	57

XXVIII.—BURSERACEÆ.

14th March,
1917.

Salai Bark (*Boswellia serrata*) :—

Tannin absorbed by Chromed			
Hide Powder . . .			13.09
Soluble non-tannins . . .			21.94
Insoluble matter . . .			64.97
TOTAL . .			100.00

Non-tannin : Tannin = 1.7 : 1.

XXXV.—RHAMNACEÆ.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

GOTHAR.

Zizyphus xylopyrus (Gothar, Ghont, etc.)
fruit.

19th July,
1917.

I. Maihar sample, over-ripe, taken
April 1917 :—

	Flesh.	Stones.
Tannin absorbed by Chromed Hide Powder .	21.17	3.90
Soluble non-tan- nins . . .	25.91	5.95
Insoluble matter .	52.92	90.15
TOTAL .	100.00	100.00

Non-tannin : Tannin = 1.22 : 1 and 1.5 : 1.

2nd August,
1917.

II. Green, taken July 1917 (without
stones) :—

Tannin absorbed by Chromed Hide Powder . . .	16.63
Soluble non-tannins . . .	16.55
Insoluble matter . . .	66.82
TOTAL .	100.00

Non-tannin : Tannin = 1 : 1.

III. Green, taken September 1917 . .

22.90

NOTE.—Gothar yields a thick gummy infusion and special methods have to be adopted for its extraction and filtration. A few drops of either acid (Hydrochloric) or alkali (Caustic soda) render the infusion readily filtrable, but this was not done in the above analysis. It may be noted that alkalis darken, whereas acids rather improve the colour of the infusion which however, naturally, is of quite a light reddish brown tinge.

Colour analysis of infusion of Green
Gothar fruit calculated to 0.5%
Tannin Strength :—

Red . . .	21.5
Yellow . . .	30.4

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

GOTHAR—*contd.*

15th January,
1918.

IV. Gothar fruit without stones—dried whole, then crushed and stones taken out ;—Maihar sample :—

Tannin absorbed by Chromed	
Hide Powder . . .	16.47
Soluble non-tannins . . .	27.57
Insoluble matter . . .	55.96
TOTAL . . .	<u>100.00</u>

Non-tannin : Tannin = 1.7 : 1.

Colour analysis * calculated to a standard of 0.5% Tannin Strength :—

Red . . .	9
Yellow . . .	25

15th January,
1918.

V. Gothar stones with some flesh still left adhering as when flesh is removed in practice ;—Maihar sample :—

Tannin absorbed by Chromed	
Hide Powder . . .	8.66
Soluble non-tannins . . .	14.57
Insoluble matter . . .	76.77
TOTAL . . .	<u>100.00</u>

Non-tannin : Tannin = 1.7 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	12.5
Yellow . . .	29.5

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

GOthAR—concl'd.

2nd February,
1918.

VI. Green Gothar flesh carefully picked
from October-November fruits :—
all green flesh :—

Tannin absorbed by Chromed			
Hide Powder	.	.	21.38
Soluble non-tannins	.	.	32.28
Insoluble matter	.	.	46.34
TOTAL			100.00

23.01%.

Non-tannin : Tannin = 1.5 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red	.	.	.	7.6
Yellow	.	.	.	14.3

VII. Shelled Gothar from Mr. Sampson
of Ganjam collected October
1917—perfect unrotted sample
of flesh

34%.

VIII. Green Gothar fruit without stones,
Maihar sample

22.09%.

BER.

Zizyphus nummularia.

25th January, 1918. I. Leaves—Maihar sample :—

Tannin absorbed by Chromed			
Hide Powder	.	.	9.12
Soluble non-tannins	.	.	16.78
Insoluble matter	.	.	74.10
TOTAL			100.00

Non-tannin : Tannin = 1.8 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red	.	.	.	6
Yellow	.	.	.	16.5

Tannin Estima-
tion by Lead-
(Pb.) method
calculated to-
Dry material

BER—*contd.*

25th February,
1918.

II. Twig bark from coppice shoots,
average of 3 maunds from Jhansi
Division :—

Tannin absorbed by Chromed	
Hide Powder . . .	11.70
Soluble non-tannins . . .	18.79
Insoluble matter . . .	69.51
TOTAL .	<u>100.00</u>

Non-tannin : Tannin = 1.6 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red . . .	4.5
Yellow . . .	9.0

24th January,
1918.

III. Old Twig bark from ordinary bushes,
average of 3 maunds 3 seers from
Jhansi.

Tannin absorbed by Chromed	
Hide Powder . . .	9.89
Soluble non-tannins . . .	12.73
Insoluble matter . . .	77.38
TOTAL .	<u>100.00</u>

Non-tannin : Tannin = 1.3 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red . . .	10.9
Yellow . . .	17.2

XXXVIII.—ACERACEÆ.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

MAPLE.

26th February, 1918. *Acer campbellii* (Himalayan Maple) ma-
ture bark from Darjeeling :—

Tannin absorbed by Chromed			
Hide Powder . . .		3.19	• 3.40%
Soluble non-tannins . . .		6.84	
Insoluble matter . . .		89.97	
TOTAL .		100.00	

Non-tannin : Tannin = 2 : 1.

XLI.—ANACARDIACEÆ.

KASHEW NUT.

19th December, 1917. *Anacardium occidentale* (Kashew nut tree)
bark from the Director of Industries,
Madras :—

Tannin absorbed by Chromed			
Hide Powder . . .		9.43	
Soluble non-tannins . . .		9.40	
Insoluble matter . . .		81.17	
TOTAL .		100.00	

Non-tannin : Tannin = 1 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red . . .	30.0
Yellow . . .	50.6
Black . . .	2.4

RHUS.

12th December, 1917. *Rhus mysorensis* twig bark from Conserva-
tor of Forests, Southern Circle,
Madras :—

Tannin absorbed by Chromed			
Hide Powder . . .		18.52	
Soluble non-tannins . . .		15.44	
Insoluble matter . . .		66.04	
TOTAL .		100.00	

Non-tannin : Tannin = 1 : 1.2.

RHUS—*contd.*

[Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

Standard Colour analysis calculated
to 0.5% Tannin Strength :—

Red	3
Yellow	6

1st March, 1918. *Rhus acuminata* mature bark :—

Tannin absorbed by Chromed		
Hide Powder	9.78	10.63%
Soluble non-tannins	7.73	
Insoluble matter	82.49	
	<hr/>	
TOTAL	100.00	
	<hr/>	
Non-tannin : Tannin=1 : 1.3.		

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red	13.3
Yellow	15.6

12th February, 1918. *Rhus semialata* mature bark :—

Tannin absorbed by Chromed		
Hide Powder	7.84	8.30%
Soluble non-tannins	14.75	
Insoluble matter	77.41	
	<hr/>	
TOTAL	100.00	
	<hr/>	
Non-tannin : Tannin=1.9 : 1.		

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red	11.7
Yellow	13.3

XLV.—LEGUMINOSÆ.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

BABUL.

20th November, *Acacia arabica*—
1917.

Pods :—

(1) collected green—seeds largely
removed before analysis—from
Forest Ranger, Maudha :—

Tannin absorbed by Chromed

Hide Powder . . .	16.86	16.99%
Soluble non-tannins . . .	26.43	
Insoluble matter . . .	56.71	
TOTAL .	100.00	

Non-tannin : Tannin = 1.6 : 1.

7th December,
1917.

(2) collected dry without seeds—ripe
husks picked up from beneath the
trees—from Forest Ranger,
Maudha :—

Tannin absorbed by Chromed

Hide Powder . . .	19.76	18.63%
Soluble non-tannins . . .	27.09	
Insoluble matter . . .	53.15	
TOTAL .	100.00	

Non-tannin : Tannin = 1.4 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red . . .	6.9
Yellow . . .	26.0

“ WATTLE.”

24th February, *Acacia dealbata* from D. F. O., Ootaca-
1918. mund :—average samples of 1,421
lbs. :—

Tannin absorbed by Chromed

Hide Powder . . .	11.85	12.00
Soluble non-tannins . . .	6.89	(from sepa-
Insoluble matter . . .	81.26	rate sample)
TOTAL .	100.00	

Non-tannin : Tannin = 1 : 1.7.

“ WATTLE ”—*contd.*

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red	22
Yellow	47

CUTCH.

20th November, *Acacia catechu* :—
1917.

I. Thick liquid cutch from A. H.
Mirza, Esq., of Ramnagar :—

	Figures Calculated as obtained. to dry.		
Tannin absorbed by Chromed Hide Powder .	24.82	52.70	24.12% (original figure).
Soluble non-tan- nins	20.28	43.05	The calculation to DRY is given for com- parison with raw tanstuffs.
Insolubles	2.00	4.25	
Moisture	52.90	0.00	
TOTAL	100.00	100.00	

Non-tannin : Tannin=1 : 1.2.

24th February, II. Twig bark from coppice shoots—
1918. average of 3 maunds from
Jhansi :—

Tannin absorbed by Chromed Hide Powder	7.45
Soluble non-tannins	24.61
Insoluble matter	67.94
TOTAL	100.00

Non-tannin : Tannin=3.3 : 1

Standard colour analysis calculated
to 0.5% Tannin Strength :—

Red	8.2
Yellow	10.0
Black	0.7

REUNJA.

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

12th October, 1917. *Acacia leucophloea* galls from Divisional Forest Officer, Damoh :—

Tannin absorbed by Chromed Hide Powder . . .	5.91
Soluble non-tannins . . .	7.58
Insoluble matter . . .	86.51
TOTAL . . .	100.00

Non-tannin : Tannin = 1.3 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	66
Yellow . . .	154
Black . . .	5.5

DIVI DIVI.

20th November, 1917. *Cæsalpinia coriaria*—Sample from Madras :—

Tannin absorbed by Chromed Hide Powder . . .	44.52
Soluble non-tannins . . .	23.57
Insolubles . . .	31.91
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.9.

TURWAD.

22nd February, 1917. *Cassia auriculata*—
Average sample of twigs from Dharavi, Bombay :—

Tannin absorbed by Chromed Hide Powder . . .	21.10
Soluble non-tannins . . .	9.91
Insoluble matter . . .	68.99
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 2.13.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

TURWAD—*contd.*

7th February, 1918. Turwad bark from Experimental cultivation at Etawah—4 seers sample :—

Tannin absorbed by Chromed		
Hide Powder	19.51	20.18%
Soluble non-tannins . . .	14.69	
Insoluble matter	65.80	
TOTAL	<u>100.00</u>	

Non-tannin : Tannin = 1 : 1.3.

Standard colour analysis calculated to 0.5% Tannin Strength :—

Red	4
Yellow	8

September, 1917. Turwad from Ajmer forwarded by R. G. Marriott, Esq. 17.3%.

18th February, 1917. "Spent Turwad" from Dharavi, Bombay :—

Tannin absorbed by Chromed	
Hide Powder	6.98
Soluble non-tannins . . .	3.38
Insoluble matter	89.64
TOTAL	<u>100.00</u>

Non-tannin : Tannin = 1 : 2.

8th March, 1918. Turwad from Etawah, exhausted material after use in Tannery, Maihar :—

Tannin absorbed by Chromed		
Hide Powder	5.11	5.35%
Soluble non-tannins . . .	2.26	
Insoluble matter	92.63	
TOTAL	<u>100.00</u>	

Non-tannin : Tannin = 1 : 2.3.

Colour of filtered infusion to Standard :—

Red	7.3
Yellow	16.7

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

TURWAD—concl'd.

11th March, "Turwad" sweepings :—

1917.

Tannin absorbed by Chromed	
Hide Powder . . .	9.02
Soluble non-tannins . . .	6.43
Insoluble matter . . .	84.55
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.4.

22nd February, *Cassia thora*—old green stalks :—

1917.

Tannin	6.02
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MAHURAIN.

20th November, *Bauhinia vahlii* :—

1917.

Leaves—Tannin	3.3%
-------------------------	------

8th March, Leaves, average of 1 maund 1 seer, from
1918. Deputy Conservator of Forests,
Gorakhpur Division :—

Tannin absorbed by Chromed	
Hide Powder	5.99
Soluble non-tannins	16.97
Insoluble matter	77.04
TOTAL	100.00

Non-tannin : Tannin = 2.8 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
strength :—

Red	5
Yellow	17.5

16th June, Mahurain leaves and twigs from
1917. Gonda :—

Tannin absorbed by Chromed	
Hide Powder	7.68
Soluble non-tannins	16.14
Insoluble matter	76.18
TOTAL	100.00

Non-tannin : Tannin = 2.1 : 1.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material

MAHURAIN—*contd.*

20th March, 1918. Mahurain twigs—1 maund 18 seers
sample from D. F. O., Gorakhpur :—

Tannin absorbed by Chromed	
Hide Powder . . .	3.81
Soluble non-tannins . . .	10.36
Insoluble matter . . .	85.83
TOTAL . . .	<u>100.00</u>

Non-tannin : Tannin = 2.7 : 1.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red . . .	20
Yellow . . .	61

17th May, 1917. Inner structure of climber : not fully
dried before despatch to Maihar by
Post, and somewhat blackened :—

Tannin absorbed by Chromed	
Hide Powder . . .	0.57
Soluble non-tannins . . .	9.50
Insoluble matter . . .	89.93
TOTAL . . .	<u>100.00</u>

17th May, 1917. Inner structure of small log separated
at Maihar :—

Tannin absorbed by Chromed	
Hide Powder . . .	4.78
Soluble non-tannins . . .	10.49
Insoluble matter . . .	84.73
TOTAL . . .	<u>100.00</u>

Non-tannin : Tannin = 2.2 : 1.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

MAHURAIN—*contd.*

3rd June, 1917. Inner structure of much larger log :—

Tannin absorbed by Chromed		
Hide Powder . . .		10.17
Soluble non-tannins . . .		15.80
Insoluble matter . . .		74.03
TOTAL . . .		100.00

Non-tannin : Tannin=1.5 : 1.

27th May, 1917. Outer bark of log as in the above :—

Tannin absorbed by Chromed		
Hide Powder . . .		17.25
Soluble non-tannins . . .		19.05
Insoluble matter . . .		63.70
TOTAL . . .		100.00

Non-tannin : Tannin=1.1 : 1.

25th July, 1917. Mahurain bark, outer portion only :—

Tannin absorbed by Chromed		
Hide Powder . . .		7.51
Soluble non-tannins . . .		11.32
Insoluble matter . . .		81.17
TOTAL . . .		100.00

Non-tannin : Tannin=1.5 : 1.

10th April, 1917. Sample Mahurain bark from Manikpur :—

Tannin absorbed by Chromed		
Hide Powder . . .		9.29
Soluble non-tannins . . .		14.55
Insoluble matter . . .		76.16
TOTAL . . .		100.00

Non-tannin : Tannin=1.57 : 1.

13th December, 1917. Sample Mahurain Inner wood—chopped, from South Banda division :—

Tannin absorbed by Chromed		
Hide Powder . . .		3.14
Soluble non-tannins . . .		7.10
Insoluble matter . . .		89.76
TOTAL . . .		100.00

Non-tannin : Tannin=2.3 : 1.

3.93%

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

MAHURAIN—conold.

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red . . .	21.3
Yellow . . .	52.6

*MADHAULIA.**Bauhinia racemosa* :—

Tannin	2.3%	2.3%
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[Both Hide Powder and Lead (Pb.) analysis by Mr. S. P. Chowdry.]

PYINGADU.

22nd May,
1917.

Xylia dolabriformis :—

Young bark from Burma :—

Tannin absorbed by Chromed Hide Powder . . .	14.45
Soluble non-tannins . . .	17.05
Insoluble matter . . .	68.50
TOTAL . . .	100.00

Non-tannin : Tannin=1.2 : 1.

NOTE.—Yields a pinky infusion which filters readily and seems to contain very little insoluble "Reds."

14th March,
1918.

Bark from the Forest Commissioner,
Madras; at the instance of the Director
of Industries, Madras :—

Tannin absorbed by Chromed Hide Powder . . .	6.82
Soluble non-tannins . . .	7.19
Insoluble matter . . .	85.99
TOTAL . . .	100.00

Non-tannin : Tannin=1 : 1 (approx.).

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	30
Yellow	47

SHISHAM.

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

3rd June,
1917.

Dalbergia sissoo, Shisham Pods :—

Tannin absorbed by Chromed	
Hide Powder . . .	1.62
Soluble non-tannins . . .	12.31
Insoluble matter . . .	86.07
TOTAL .	100.00

XLVIII.—HAMAMELIDACEÆ.

PIPLI.

1st March,
1918.

Bucklandia populanea from Darjeeling :—

Tannin absorbed by Chromed		
Hide Powder . . .	10.67	11.28%
Soluble non-tannins . . .	10.03	
Insoluble matter . . .	79.30	
TOTAL .	100.00	

Non-tannin : Tannin = 1 : 1.

Standard colour analysis calculated
to 0.5% Tannin Strength :—

Red . . .	6.9
Yellow . . .	13.8

XLIX.—RHIZOPHORACEÆ.

MANGROVES.

12th October,
1917.

Bruguiera caryophylloides bark from
Killai, South Arcot, Madras :—

Tannin absorbed by Chromed	
Hide Powder . . .	18.41
Soluble non-tannins . . .	10.49
Insoluble matter . . .	71.10
TOTAL .	100.00

Non-tannin : Tannin = 1 : 1.76.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

MANGROVES—*contd.*

Colour analysis calculated to a
standard of 0.5% Tannin
Strength :—

Red	13.60
Yellow	30.21

NOTE.—Chlorides (as NaCl)=0.76%.

23rd August, 1917. *Ceriops roxburghiana* (Hindi : “Goran”) from National Tannery, Calcutta :—

Tannin absorbed by Chromed	
Hide Powder	27.73
Soluble non-tannins	8.15
Insoluble matter	64.12
TOTAL	100.00

Non-tannin : Tannin=1 : 3.28.

NOTE.—Chlorides (as NaCl.)=1.02%.

7th October, 1917. *Ceriops candolleana* (also known in Hindi as “Goran”) :—

Tannin absorbed by Chromed	
Hide Powder	22.60
Soluble non-tannins	10.72
Insoluble matter	66.68
TOTAL	100.00

Non-tannin : Tannin=1 : 2.1.

NOTE.—Chlorides (as NaCl.)=1.34%.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	28
Yellow	43

MANGROVES—*concl'd.*

Tannin Estima-
tion by Lead
(Pb.) method.
calculated to
Dry material.

12th October, 1917. *Rhizophora mucronata* bark from Killai,
South Arcot, Madras :—

Tannin absorbed by Chromed	
Hide Powder . . .	22.17
Soluble non-tannins . . .	16.76
Insoluble matter . . .	61.07
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.3.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red . . .	10.74
Yellow . . .	26.85

NOTE.—Chlorides (as NaCl.) = 1.46%.

L.—COMBRETACEÆ.

DHAWA.

Anogeissus latifolia :—

I. Dhawa leaves with twigs :—

Tannin absorbed by Chromed	
Hide Powder . . .	9.77
Soluble non-tannins . . .	10.06
Insoluble matter . . .	80.17
TOTAL . . .	100.00

Non-tannin : Tannin = approx. 1 : 1.

27th March, 1917. II. Dhawa mature leaves without
twigs :—

Tannin absorbed by Chromed	
Hide Powder . . .	14.35
Soluble non-tannins . . .	17.40
Insoluble matter . . .	68.25
TOTAL . . .	100.00

Non-tannin : Tannin = 1.2 : 1.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

DHAWA—*contd.*

23rd August, III. Dhawa leaves from D. F. O., Bala-
1917. ghat :—

Tannin absorbed by Chromed	
Hide Powder . . .	16.03
Soluble non-tannins . . .	17.96
Insoluble matter . . .	66.01
TOTAL . . .	100.00

Non-tannin : Tannin = 1.1 : 1.

24th January, IV. Dhawa leaves, finer portion pro-
1918. perly collected, all green autumn
leaves, no sticks, milled once
and sieved :—

Tannin absorbed by Chromed	
Hide Powder . . .	15.90
Soluble non-tannins . . .	13.16
Insoluble matter . . .	70.94
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.2.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red . . .	5
Yellow . . .	18.5

15th February, V. Dhawa leaves, average of 1 bag
1918. submitted to David Sassoon &
Co., from Sleemanabad :—

Tannin absorbed by Chromed	
Hide Powder . . .	16.21
Soluble non-tannins . . .	14.66
Insoluble matter . . .	69.13
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.2.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

DHAWA—*contd.*

Colour analysis calculated to a Stan-
dard of 0.5% Tannin Strength :—

Red . . .	5.3
Yellow . . .	25.3

19th February, 1918. VI. Dhawa leaves from Ganeshgunj,
also submitted to David Sassoon
& Co. :—

Tannin absorbed by Chromed	
Hide Powder . . .	13.35
Soluble non-tannins . . .	15.47
Insoluble matter . . .	71.18
TOTAL . . .	100.00

Non-tannin : Tannin = 1.15 : 1.

Dhawa Sumac :—

8th March, 1917. I. Dhawa Sumac, sample from browsed
coppice stools, Sharda Devi hill,
Maihar :—

Tannin absorbed by Chromed	
Hide Powder . . .	25.23
Soluble non-tannins . . .	17.47
Insoluble matter . . .	57.30
TOTAL . . .	100.00

Non-tannin : Tannin = Approx. 1 : 1.4.

NOTE.—Infusion greenish brown.

8th March, 1917. II. Dhawa Sumac, sample from pruned
branches of trees (red leaves) from
Sharda Devi, Maihar :—

Tannin absorbed by Chromed	
Hide Powder . . .	48.41
Soluble non-tannins . . .	14.65
Insoluble matter . . .	36.94
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 3.3.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

DHAWA—contd.

2nd May,
1917.

III. Dhawa Sumac from 1916 coppice,
trimmed free from old leaves and
ends, by Mr. W. A. Fraymouth,
March 1917 :—

Tannin absorbed by Chromed	
Hide Powder . . .	33.10
Soluble non-tannins . . .	17.48
Insoluble matter . . .	49.42
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.9.

20th April,
1917.

IV. Dhawa Sumac, Majhgawan sample,
from normal sized leaves :—

Tannin absorbed by Chromed	
Hide Powder . . .	25.06
Soluble non-tannins . . .	16.68
Insoluble matter . . .	58.26
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.5.

20th April,
1917.

V. Dhawa Sumac, Majhgawan sample,
from larger leaves :—

Tannin absorbed by Chromed	
Hide Powder . . .	12.84
Soluble non-tannins . . .	12.05
Insoluble matter . . .	75.11
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.

VI. Sumac from Conservator of Forests,
Southern Circle, Madras, large and
small leaves together :—

7th October,
1917.

(1) large proportion of red
leaves :—

Tannin absorbed by Chromed	
Hide Powder . . .	33.14
Soluble non-tannins . . .	16.11
Insoluble matter . . .	50.75
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 2.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry $\frac{1}{2}$ material.

DHAWA—*contd.*

7th October,
1917.

(2) green leaves :—

Tannin absorbed by Chromed			
Hide Powder	.	.	24.99
Soluble non-tannins	.	.	14.08
Insoluble matter	.	.	60.03
TOTAL			100.00

Non-tannin : Tannin = 1 : 1.7.

NOTE.—Both the above are Kodaikanal Ghat samples.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

	Large proportion of Red Leaves.	Green Leaves.
Red	1.62	3.18
Yellow	6.83	13.07
Black	0.12	0.11

31st October,
1917.

VIII. Rosy 'Sumac'—*Anogeissus latifolia* product prepared entirely from various sizes of red leaves in Madras, by P. M. Lushington, Esq., I.F.S., Conservator of Forests, Southern Circle, Madras :—

Tannin absorbed by Chromed			
Hide Powder	.	.	49.21
Soluble non-tannins	.	.	14.02
Insoluble matter	.	.	36.77
TOTAL			100.00

Non-tannin : Tannin = 1 : 3.5.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	.	.	1.75
Yellow	.	.	5.8

DHAWA—*contd.*

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

5th February, 1918. IX. Dhawa 'Sumac'—Tinnevelly sample
No. 1, leaves dried and sieved,

large percentage of red leaf :—

Tannin absorbed by Chromed			
Hide Powder . . .	54.59		54.66%
Soluble non-tannins . . .	14.46		
Insoluble matter . . .	30.95		
TOTAL . . .	100.00		

Non-tannin : Tannin = 1 : 3.8.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red . . .	1.4
Yellow . . .	4.6

5th February, 1918. X. Sample No. 2, residue after sieving
No. 1 put through a mill and
reduced to fine powder :—

Tannin absorbed by Chromed			
Hide Powder . . .	49.98		52.87%
Soluble non-tannins . . .	14.27		
Insoluble matter . . .	35.75		
TOTAL . . .	100.00		

Non-tannin : Tannin = 1 : 3.5.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red . . .	1.9
Yellow . . .	5.0

15th February, 1918. XI. Dhawa 'Sumac' average of large
bulk—dirty from Majhgawan :—

Tannin absorbed by Chromed			
Hide Powder . . .	19.75		
Soluble non-tannins . . .	15.29		
Insoluble matter . . .	64.96		
TOTAL . . .	100.00		

Non-tannin : Tannin = 1 : 1.3.

DHAWA--contd.

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	3.7
Yellow . . .	14.8

12th March,
1918.

XII. Dhawa 'Sumac,' average sample from 20 bags cleaned at Maihar ("sooped") :—

Tannin absorbed by Chromed	
Hide Powder . . .	20.01
Soluble non-tannins . . .	15.14
Insoluble matter . . .	64.85
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.3.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	2.7
Yellow . . .	14.3

24th April,
1918.

XIII. Dhawa petioles :—

Tannin absorbed by Chromed	
Hide Powder . . .	15.73
Soluble non-tannins . . .	16.09
Insoluble matter . . .	68.18
TOTAL . . .	100.00

Non-tannin : Tannin = practically 1 : 1.

15th February,
1917.

XIV. Dhawa Twig bark :—

Tannin absorbed by Chromed	
Hide Powder . . .	13.48
Soluble non-tannins . . .	17.17
Insoluble matter . . .	69.35
TOTAL . . .	100.00

Non-tannin : Tannin = 1.27 : 1.

Tannin Estima-
tion by Lead
(Pb.) method.
calculated to
Dry material.

DHAWA—concl'd.

15th February, 1917. XV. Dhawa mature bark :—

Tannin absorbed by Chromed	
Hide Powder . . .	15.50
Soluble non-tannins . . .	8.83
Insoluble matter . . .	75.67
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.75.

15th March, 1917. XVI. Dhawa bark from girdled trees in United Provinces :—

Tannin absorbed by Chromed	
Hide Powder . . .	11.73
Soluble non-tannins . . .	5.85
Insoluble matter . . .	82.42
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 2.

YÔN.

Anogeissus acuminata—Burma samples :—

5th February, 1918. I. Leaves—sample over a year old :—

Tannin absorbed by Chromed	
Hide Powder . . .	9.37
Soluble non-tannins . . .	9.63
Insoluble matter . . .	81.00
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	13
Yellow . . .	56

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

YÔN—contd.

29th March,
1918.

II. *Anogeissus acuminata* (Yôn) leaves
from A. Rodger, Esq., Forest
Research Officer, Burma :—

	Young leaves.	Rather older leaves.
Tannin absorbed by Chromed Hide Powder .	32.32	9.95
Soluble non-tannins . .	16.22	22.51
Insoluble matter .	51.46	67.54
TOTAL .	<u>100.00</u>	<u>100.00</u>

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	2.9	12.8
Yellow . . .	11.5	64.0

5th March,
1918.

III. Yôn, bark :—

Tannin absorbed by Chromed Hide Powder . . .	10.06
Soluble non-tannins . . .	8.74
Insoluble matter . . .	81.20
TOTAL .	<u>100.00</u>

Non-tannin : Tannin = 1 : 1.15.

NOTE.—A chestnut coloured liquor, rather gummy.

5th March,
1917.

IV. Yôn, Mature bark :—

Tannin absorbed by Chromed Hide Powder . . .	14.36
Soluble non-tannins . . .	5.79
Insoluble matter . . .	79.85
TOTAL .	<u>100.00</u>

Non-tannin : Tannin = 1 : 2.14.

NOTE.—Colour considerably darker than with the young bark.

DHO.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

Anogeissus pendula :—

15th March,
1917.

I. Leaves :—

	(1) Small.	(2) Large.
Tannin absorbed by Chromed Hide Powder .	23.19	6.71
Soluble non-tannins .	18.09	15.26
Insoluble matter .	58.72	78.03
TOTAL .	100.00	100.00

Non-tannin : Tannin=1 : 1.28 and 2.27 : 1.

Anogeissus pendula :—

15th March,
1917.

II. Bark [By Lead (Pb.) method] :—

Tannin	12.09
Soluble non-tannins . .	15.20
Insoluble matter . . .	72.71
TOTAL . . .	100.00

Non-tannin : Tannin=1.25 : 1.

9th February,
1918.

III. *Anogeissus pendula* bark, average
of 7 maunds 39 seers from
Jhansi :—

Tannin absorbed by Chromed Hide Powder	9.09
Soluble non-tannins . . .	6.60
Insoluble matter	84.31
TOTAL . . .	100.00

7.74

Non-tannin : Tannin=1.4 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	15
Yellow	50

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

KAHUA.

Terminalia arjuna :—

26th July,
1917.

I. Kahua fruit :—

Tannin absorbed by Chromed	
Hide Powder . . .	20.58
Soluble non-tannins . . .	20.03
Insoluble matter . . .	59.39
TOTAL . . .	100.00

Non-tannin : Tannin=Approx. 1 : 1.

NOTE.—The infusion is gummy and difficult to filter, but is free from difficulty soluble-
“ Reds.”

Terminalia Arjuna (“ Kahua ”) :—

16th March,
1918.

II. Sample young bark from Khandwah
sent by Haji Eisa of Bombay :—

Tannin absorbed by Chromed	
Hide Powder . . .	16.82
Soluble non-tannins . . .	10.51
Insoluble matter . . .	72.67
TOTAL . . .	100.00

Non-tannin : Tannin=1 : 1.6.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red . . .	12.3
Yellow . . .	21.25
Black . . .	0.2

Kahua :—

20th March,
1918.

III. Bulk of comparatively young bark
in stock at Maihar (local collec-
tion) :—

Tannin absorbed by Chromed	
Hide Powder . . .	19.61
Soluble non-tannins . . .	12.90
Insoluble matter . . .	67.49
TOTAL . . .	100.00

Non-tannin : Tannin=1 : 1.5.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

KAHUA—*contd.*

30th March, 1918. IV. Kahua bark, regrown bark supplied by Maihar State Forest Officer :—

Tannin absorbed by Chromed	
Hide Powder . . .	17.94
Soluble non-tannins . . .	12.46
Insoluble matter . . .	69.60
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.4.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	5.9
Yellow . . .	8.8

BAHERA.

Terminalia belerica :—

2nd August, 1917. I. Twig bark :—

Tannin absorbed by Chromed	
Hide Powder . . .	10.09
Soluble non-tannins . . .	5.99
Insoluble matter . . .	83.92
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.68.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	14.75
Yellow . . .	21.77
Black . . .	0.70

Terminalia Belerica :—

2nd August, 1917. II. Old bark :—

Tannin absorbed by Chromed	
Hide Powder . . .	6.98
Soluble non-tannins . . .	12.74
Insoluble matter . . .	80.28
TOTAL . . .	100.00

Non-tannin : Tannin = 1.8 : 1.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

BAHERA.—*contd.*

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	.	.	.	18
Yellow	.	.	.	56

NOTE.—Infusion much yellower in appearance than that of the Twig bark.

20th March, 1918. III. *Terminalia belerica* fruit, flesh with-
out stones, from Amdara :—

Tannin absorbed by Chromed			
Hide Powder	.	.	25.48
Soluble non-tannins	.	.	39.02
Insoluble matter	.	.	35.50
TOTAL			100.00

Non-tannin : Tannin = 1.3 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	.	.	.	1.8
Yellow	.	.	.	6.3

21st March, 1918. IV. Crushed stones of fruit :—

Tannin absorbed by Chromed			
Hide Powder	.	.	14.41
Soluble non-tannins	.	.	26.39
Insoluble matter	.	.	59.20
TOTAL			100.00

Non-tannin : Tannin = 1.8 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	.	.	.	2
Yellow	.	.	.	7.3

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

MYRABOLANS.

Terminalia chebula fruit (the common
Myrabolans) :—

22nd May,
1917.

(Crushed sample without stones) :—

Tannin absorbed by Chromed	
Hide Powder . . .	49.95
Soluble non-tannins . . .	29.24
Insoluble matter . . .	20.81
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.7.

SAJ.

Terminalia tomentosa :—

4th May,
1917.

Twig bark collected at Sleemanabad—
April 25th by Mr. W. A. Fray-
mouth :—

Tannin absorbed by Chromed	
Hide Powder . . .	12.30
Soluble non-tannins . . .	16.81
Insoluble matter . . .	70.89
TOTAL . . .	100.00

Non-tannin : Tannin = 1.4 : 1.

LI.—MYRTACEÆ.

JAMON.

Eugenia jambolana :—

26th July,
1917.

I. "Sumac" :—

Tannin absorbed by Chromed	
Hide Powder . . .	12.80
Soluble non-tannins . . .	13.80
Insoluble matter . . .	73.40
TOTAL . . .	100.00

Non-tannin : Tannin = 1.1 : 1.

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

JAMON—contd.

25th July,
1917.

II. Bark :—

Tannin absorbed by Chromed	
Hide Powder . . .	8.66
Soluble non-tannins . .	8.39
Insoluble matter . . .	82.95
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.

Eugeonia dalbergioides (Sandan)

7.33%

LIII.—LYTHRACEÆ.

SEJA.

Lagerstrœmia parviflora :—

18th May,
1917.

I. Seja twigs from Bellraien, Kheri :—

Tannin absorbed by Chromed	
Hide Powder . . .	3.52
Soluble non-tannins . .	11.41
Insoluble matter . . .	85.07
TOTAL . . .	100.00

Non-tannin : Tannin = 3.2 : 1.

4th May,
1917.

II. Seja twig bark, Sleemanabad sample, collected 25th April 1917 by Mr. Fraymouth :—

Tannin absorbed by Chromed	
Hide Powder . . .	8.79
Soluble non-tannins . .	15.21
Insoluble matter . . .	76.00
TOTAL . . .	100.00

Non-tannin : Tannin = 1.7 : 1.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

SEJA—*contd.*

18th May,
1917.

III. Seja twig bark from Bellraien,
Kheri :—

Tannin absorbed by Chromed	
Hide Powder . . .	10.02
Soluble non-tannins . . .	12.38
Insoluble matter . . .	77.60
TOTAL . . .	100.00

Non-tannin : Tannin = 1.23 : 1.

17th April,
1917.

IV. Seja bark :—

Tannin absorbed by Chromed	
Hide Powder . . .	10.31
Soluble non-tannins . . .	13.02
Insoluble matter . . .	76.67
TOTAL . . .	100.00

Non-tannin : Tannin = 1.25 : 1.

24th April,
1917.

V. Seja bark,—another sample with
natural black marking :—

Tannin absorbed by Chromed	
Hide Powder . . .	9.88
Soluble non-tannins . . .	15.10
Insoluble matter . . .	75.02
TOTAL . . .	100.00

Non-tannin : Tannin = 1.5 : 1.

Sonneratia apetala (—A “Mangrove”) :—

18th October,
1917.

I. Leaves and petioles from Killai,
South Arcot, Madras :—

Tannin absorbed by Chromed	
Hide Powder . . .	8.50
Soluble non-tannins . . .	16.14
Insoluble matter . . .	75.36
TOTAL . . .	100.00

Non-tannin : Tannin = 1.9 : 1.

SEJA—concl'd.

Tannin Estima-
tion by Lead.
(Pb.) method.
calculated to
Dry material.

18th October,
1917.

II. *Sonneratia apetala* bark from Killai,
South Arcot, Madras :—

Tannin absorbed by Chromed			
Hide Powder . . .	8.04		8.52%
Soluble non-tannins . . .	10.14		
Insoluble matter . . .	81.82		
TOTAL . . .	100.00		

Non-tannin : Tannin = 1.3 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	25
Yellow	52.5
Black	2

THAWAI.

Woodfordia floribunda :—

Mature leaf	20.2%
Green leaf	12.4%
Bark	22.7%

LXI.—RUBIACEÆ.

Adina cordifolia :—

Young bark	7.27%
Old bark	9.70%

LXXIII.—APOCYNACEÆ.

KARUNDA.

Carissa spinarum (Karunda) :—

22nd May,
1917.

I. Leaves, Markundi sample collected
on 15th May 1917 :—

Tannin absorbed by Chromed			
Hide Powder . . .	12.34		
Soluble non-tannins . . .	25.28		
Insoluble matter . . .	62.38		
TOTAL . . .	100.00		

Non-tannin : Tannin = 2 : 1.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

KARUNDA—*contd.*

22nd May,
1917.

II. Leaves, Mailhar sample :—

Tannin absorbed by Chromed	
Hide Powder	10.95
Soluble non-tannins . . .	25.55
Insoluble matter	63.50
TOTAL	<u>100.00</u>

Non-tannin : Tannin = 2.3 : 1.

3rd June,
1917.

III. Young green leaves from Sharda
Devi Hills

11.30%

3rd June,
1917.

IV. Larger mature leaves

14.90%

18th October,
1917.

V. Comparison of *Carissa spinarum*
leaves and *Carissa carandas*
leaves; both samples from the
District Forest Officer, South
Vellore, Madras :—

	(1) <i>Carissa</i> <i>spinarum</i> .	(2) <i>Carissa</i> <i>carandas</i> .	
Tannin absorbed by Chromed			
Hide Powder	9.36	6.52	(1) 8.65%
Soluble non-tan- nins	15.84	16.17	(2) 6.65%
Insoluble matter . . .	74.80	77.31	
TOTAL	<u>100.00</u>	<u>100.00</u>	

Non-tannin : Tannin = 1.7 : 1 and 2.5 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	6	20
Yellow . . .	21	63

KARUNDA—*contd.*

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

30th November, VI. *Carissa spinarum* leaves, average
1917. Maihar sample from large bulk :—

Tannin absorbed by Chromed		
Hide Powder		9.24
Soluble non-tannins		24.75
Insoluble		66.01
TOTAL		<u>100.00</u>

Non-tannin : Tannin=2.7 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	4.17
Yellow	11.67

15th January, VII. *Carissa spinarum* red leaves from
1918. Nagod plateau :—

Tannin absorbed by Chromed		
Hide Powder		8.08
Soluble non-tannins		25.87
Insoluble matter		66.05
TOTAL		<u>100.00</u>

Non-tannin : Tannin=3.2 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	7.5
Yellow	23

15th January, VIII. *Carissa spinarum* green leaves from
1918. Damoh :—

Tannin absorbed by Chromed		
Hide Powder		9.39
Soluble non-tannins		26.63
Insoluble matter		63.98
TOTAL		<u>100.00</u>

Non-tannin : Tannin=2.8 : 1.

KARUNDA—*contd.*

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red . . .	3.57
Yellow . . .	10.00

30th January, 1918. IX. Four bags of doubtful withered leaves delivered at Government Tannery, Allahabad, from Gonda ; average of bulk 38 seers obtained after cleaning :—

Tannin absorbed by Chromed	
Hide Powder . . .	5.89
Soluble non-tannins . . .	16.67
Insoluble matter . . .	77.44
TOTAL . . .	<u>100.00</u>

6.52%

Non-tannin : Tannin = 2.8 : 1.

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red . . .	16.4
Yellow . . .	40

30th January, 1918. X. Green Karunda leaves, Maihar sample—taken end of January 1918 :—

Tannin absorbed by Chromed	
Hide Powder . . .	9.86
Soluble non-tannins . . .	25.65
Insoluble matter . . .	64.49
TOTAL . . .	<u>100.00</u>

Non-tannin : Tannin = 2.6 : 1.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

KARUNDA—*concl'd.*

30th March,
1918.

XI. Karunda leaves—mid-March collec-
tion, fairly young leaves :—

Tannin absorbed by Chromed			
Hide Powder . . .	8.47		8.59%
Soluble non-tannins . . .	23.37		
Insoluble matter . . .	68.16		
TOTAL . . .	100.00		

Non-tannin : Tannin = 2.8 : 1.

XII. Young green Karunda leaves from
Messrs. Graham & Co., Calcutta.

6.2%

22nd May,
1917.

Maihar sample of Karunda leaves and
twigs (mainly twigs) :—

Tannin absorbed by Chromed		
Hide Powder . . .	4.89	
Soluble non-tannins . . .	17.29	
Insoluble matter . . .	77.82	
TOTAL . . .	100.00	

Non-tannin : Tannin = 3.5 : 1.

Karunda leaves and twigs from Mr. Samson . . .	...	8.05%
Karunda twig bark from Messrs. Graham & Co., Calcutta . . .	...	8.30%

3rd June,
1917.

Karunda bark, Maihar sample :—

Tannin absorbed by Chromed		
Hide Powder . . .	5.05	
Soluble non-tannins . . .	20.26	
Insoluble matter . . .	74.69	
TOTAL . . .	100.00	

Tannin Estima-
tion by Lead
(Pb.) method
calculated to-
Dry material.

BLACK MANGROVE.

Avicennia (Tamil, "Kari (—Black) Kan-
dan") (—a "Mangrove")—

7th October,
1917.

An "Avicennia" as affirmed by the District Forest Officer, South Arcot. It has similar fruit to *Avicennia officinalis*, but the outside of the bark has a blackish look. Inside, the bark is white and very similar to *Avicennia Officinalis*; it however gives a black decoction now although it did not when collected—13th September 1917 :—

Tannin absorbed by Chromed			
Hide Powder . . .	3.80		5.04%
Soluble non-tannins . . .	11.62		
Insoluble matter . . .	84.58		
TOTAL . . .			100.00

NOTE.—Analysis by Lead method which should precipitate Gallic acid as well as tannins comes to 5.04% which agrees with the fact that this *Avicennia* gives a far better indication with Iron-alum test than with Gelatine Salt solution (mere faint milkiness). The former reagent indicates both Galic and Tannin acids; the latter only true tannin acids.

LXXXII.—VERBENACEÆ.

TEAK.

4th April,
1917.

Teak bark from Conservator of Forests,
Pegu Circle, Burma :—

Tannin absorbed by Chromed			
Hide Powder . . .	0.42		
Soluble non-tannins . . .	19.38		
Insoluble matter . . .	80.20		
TOTAL . . .			100.00

XCVI.—LORANTHACEÆ.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

Loranthus longifloras leaves—the young
pink shoots from Gorakhpur :—

Tannin on Dry . . .	10.3%	10.2%
Soluble non-tannins . . .	20.4%	

NOTE.—Analysis, both by Hide Powder and Lead, by Mr. Chowdry.

XCVIII.—EUPHORBIACEÆ.

31st May,
1917.

Bridelia retusa (Khaja) bark from Gonda
Division, United Provinces :—

Tannin absorbed by Chromed	
Hide Powder . . .	9.72
Soluble non-tannins . . .	17.09
Insoluble matter . . .	73.19
TOTAL . . .	100.00

Non-tannin : Tannin = 1.75 : 1.

Clistanthus collinus—sample from Mr.
Samson :—

Sifted powder from leaves . . .	18.9%
Residue after sifting . . .	13.35%
Twig bark . . .	20.6 %
Dried green fruit . . .	14.4 %

AONLA.

15th February,
1918.

Phyllanthus emblica :—

Leaves from R. G. Marriott, Esq.,
sample collected June 1917, and
turned to faint grey green in
colour :—

Tannin absorbed by Chromed	
Hide Powder . . .	23.70
Soluble non-tannins . . .	14.38
Insoluble matter . . .	61.92
TOTAL . . .	100.00

Non-tannin : Tannin = 1 : 1.6.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

AONLA—*contd.*

Colour analysis calculated to a stan-
dard of 0.5% Tannin Strength :—

Red	:	:	:	1.5
Yellow	:	:	:	6.6

28th April, 1917. *Phyllanthus emblica* (Aonla) "Sumac" :—

Tannin absorbed by Chromed	
Hide Powder . . .	27.85
Soluble non-tannins . .	19.12
Insoluble matter . . .	53.03
TOTAL . .	100.00

Non-tannin : Tannin = 1 : 1.46.

28th April, 1917. *Phyllanthus emblica* petioles :—

Tannin absorbed by Chromed	
Hide Powder . . .	10.53
Soluble non-tannins . .	11.87
Insoluble matter . . .	77.60
TOTAL . .	100.00

Non-tannin : Tannin = 1.13 : 1.

28th February, 1917. *Phyllanthus emblica* twig bark :—

Tannin absorbed by Chromed	
Hide Powder . . .	19.01
Soluble non-tannins . .	10.09
Insoluble matter . . .	70.90
TOTAL . .	100.00

Non-tannin : Tannin = 1 : 1.88.

24th May, 1917. *Phyllanthus emblica* twig bark—sample
from S. Bhargava, Esq. :—

Tannin absorbed by Chromed	
Hide Powder . . .	21.60
Soluble non-tannins . .	17.18
Insoluble matter . . .	61.22
TOTAL . .	100.00

Non-tannin : Tannin = 1 : 1.26.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

AONLA—contd.

24th May,
1917.

Phyllanthus emblica twig bark from
Sleemanabad :—

Tannin absorbed by Chromed			
Hide Powder . . .			19.88
Soluble non-tannins . . .			10.21
Insoluble matter . . .			69.91
TOTAL . . .			100.00

Non-tannin : Tannin=1 : 1.94.

2nd February,
1918.

Phyllanthus emblica twig bark properly
collected and taken by Mr. Fraymouth,
from Maihar stock yard :—

Tannin absorbed by Chromed			
Hide Powder . . .			23.91
Soluble non-tannins . . .			13.14
Insoluble matter . . .			62.95
TOTAL . . .			100.00

25.23%

Non-tannin : Tannin=1 : 1.8.

Colour analysis calculated to a stan-
dard of 0.5% Tannin strength :—

Red . . .	6.8
Yellow . . .	9.1

4th April,
1917.

Phyllanthus emblica fruit (Emblie myra-
bolans) :—

Tannin absorbed by Chromed			
Hide Powder . . .			19.90
Soluble non-tannins . . .			24.30
Insoluble matter . . .			55.80
TOTAL . . .			100.00

Non-tannin : Tannin=1.22 : 1.

AONLA—contd.

Tannin Estimation by Lead (Pb.) method calculated to Dry material.

13th December, *Phyllanthus emblica* fruit :—
1917.

	(1) Crushed flesh with- out stones.	(2) Crushed stones.
Tannin absorbed by Chromed Hide Powder .	30.53	6.31
Soluble non-tan- nins .	37.15	12.03
Insoluble matter .	32.32	81.66
TOTAL .	100.00	100.00

Non-tannin : Tannin = 1.2 : 1 and 1.9 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

	(1)	(2)
Red .	0.48	1
Yellow .	2.0	2

NOTE.—The pale colour of infusions is excellent, but No. (1) (fruit without stones) shows a tendency to slight milkiness on standing.

The infusion is gummy and not easy to filter through the "candles."

15th January, Fruit flesh of Aonla without stones,
1918. Maihar sample :—

Tannin absorbed by Chromed Hide Powder . . .	26.34
Soluble non-tannins . . .	40.36
Insoluble matter . . .	33.30
TOTAL .	100.00

Non-tannin : Tannin = 1.5 : 1.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red . . .	0.0
Yellow . . .	1.1
Black . . .	0.22

AONLA—concl'd.

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

30th November, 1917. *Phyllanthus polyphyllus* twig bark—suggested by Mr. P. M. Lushington as likely to prove equally useful in place of *Phyllanthus emblica*.:—

Tannin absorbed by Chromed			16.72%.
Hide Powder	16.51		
Soluble non-tannins . . .	9.60		
Insoluble matter	73.89		
TOTAL			100.00

Non-tannin : Tannin = 1 : 1.7.

Colour analysis calculated to a standard of 0.5% Tannin Strength :—

Red	8
Yellow	17.75

CVII.—FAGACEÆ.

OAKS.

		Tannin on Dry.	Soluble non-tan- nin on Dry.	Inso- lubles on Dry.	COLOUR ANALYSIS CALCULATED TO A STANDARD OF 0.5% TANNIN STRENGTH.		
					Red.	Yellow.	
<i>Quercus pachyphylla.</i>							
15-1-18	Acorns (crushed valonea).	2.77	5.14	92.09	31.75	71.5	
17-1-18	Valonea . .	16.11	13.00	70.89	20.5	91	
8-3-18	Leaves . .	10.03	9.34	80.63	6.25	23.21	9
15-2-18	Twig bark .	12.75	12.72	74.53	10.9	43.5	14.43%
17-1-18	Mature bark .	12.24	10.75	77.01	11	40	

Quercus lineata.

26-2-18	Leaves . . .	11.06	12.33	76.61	8	33	13.15%
1-3-18	Twig bark . .	10.50	11.04	78.46	14	32	11.85%
24-1-18	Mature bark .	9.69	11.73	78.58	11.5	45.5	

Tannin Estima-
tion by Lead
(Pb.) method
calculated to
Dry material.

OAKS—contd.

		Tannin on Dry.	Soluble non- tannin on Dry.	Inso- lubles on Dry.	COLOUR ANALYSIS CALCULATED TO A STANDARD OF 0.5% TANNIN STRENGTH.	
					Red.	Yellow.
<i>Quercus lamellosa.</i>						
12-2-18	Leaves . .	7.86	12.99	79.15	16.5	60.
5-3-18	Twig bark .	7.86	12.50	79.64	25	100
2-2-18	Mature bark .	9.97	17.62	72.41	16	[55]

Quercus fenestrata.

8-3-18	Leaves . .	2.82	7.75	89.43	...	...	3.05%
5-3-18	Twig bark .	9.48	7.48	83.04	10.3	[25.8	10.03%
2-2-18	Mature bark .	15.85	8.44	75.71	4	7]	17.00%

CHESTNUTS.

Castanopsis hystrix.

12-3-18	Leaves . .	11.56	15.50	72.94	9	[29.5
16-3-18	Twig bark .	11.56	13.82	74.62	13	53
24-1-18	Mature bark .	13.00	11.81	75.19	13.5	47.5

Castanopsis tribuloides.

26-2-18	Leaves . .	2.10	13.18	84.72	...	...
19-2-18	Twig bark .	13.58	11.21	75.21	13.3	40
19-2-18	Mature bark .	6.85	5.41	87.74	17	53

Castanopsis indica.

26-2-18	Leaves . .	10.34	11.66	78.00	8.3	18.75
19-2-18	Mature bark .	[11.82	6.33	81.85	[11.5	38.5

CHAPTER XV.

NOTE ON THE PROSPECTS OF TANNIN EXTRACT MANUFACTURE IN INDIA,

BY J. A. PILGRIM.

The writer was brought out to India primarily for the purpose of preparing Solid Tannin Extracts more particularly from the Mangroves of Burma. His diversion to Maihar has, however, resulted in his becoming closely acquainted with a large number of Indian tanstuffs, and study of these, undertaken in collaboration with Mr. Fraymouth under all sorts of aspects and conditions, indicates that there are quite a number of very useful tanstuffs in India which would nevertheless be highly unsuitable for extract manufacture. On the other hand there are cases where an Extract might profitably be made from a natural material not suitable for a direct application to the hide.

One of the principal reasons for a tanstuff being unsuitable for Extract manufacture is that so often, in spite of its greater bulk, it pays better and costs less to use it as a raw material. An instance of this may be cited though it does not refer to a tanstuff which had been grown in India: Messrs. Cooper Allen & Co., Ltd., of Cawnpore, found that it cost them less per unit of tannin to import Wattle bark from South Africa than to purchase Extract made where this particular bark was grown.

It is well-known that in Europe, *liquor tanning* finds the greatest favour: but in India by far the largest number of hides at present tanned are converted into leather in direct contact with the tanstuff, and this especially applies to the crust leathers tanned for the British War Office, most of which have hitherto been tanned with *Cassia auriculata*, the 'Avaram' or 'Turwad' of Madras and Bombay. There are not wanting, those who believe that an extract-liquor prepared by leaching Turwad and concentrating the liquor with the aid of heat and vacuum would not give anything like as good a result as yielded by the twig bark itself; and this opinion might extend to many other Indian tanstuffs. India is blessed with an abundance of them of almost every type, and most districts of India have their local tanstuffs available, capable of yielding good results. It would be premature, however, to guarantee the results of these tanstuffs.

if employed in the form of a solidified extract. By this I do not wish, without proof, to assert definitely that such an Extract would *not* be useful. Such work is about to be tried in conjunction with Mr. Fraymouth's new Agitator Extraction Plant, connected to the Government Tannin Solidification Plant, and must greatly enrich our knowledge as to the suitability or otherwise of various extracts. Our plan will be to work through a list of the most promising tanstuffs on as nearly as possible a commercial scale so as to obtain the most valuable data possible.

In the meantime, I can only lay down the following general principles:—

(1) If a raw tanning material is very rich in tannin, say, 50 per cent. or thereabouts, it will probably not pay to convert it into Solid Extract.

(2) The leaching and concentration of liquors almost invariably results in a certain amount of oxidation of the tanstuff in spite of the use of *vacuum* in concentrating.

Thus a 50 per cent. tanstuff containing 25 per cent. non-tannins, should, when concentrated down to a solid extract containing 19 per cent. of moisture, analyse at 54 per cent. of tannin, and 27 per cent. soluble non-tannins. But it is quite possible that the extra 4 per cent. tannin gained in the extraction would be lost owing to oxidation into "Insolubles" and other causes. The principal gain would be that instead of having a large proportion of vegetable matter as insolubles, the third constituent could only be water—with perhaps a *small* quantity of suspended insolubles in the cold solution. But the increased concentration would be such as to affect Railway or Steamer freight very little. Some 50 per cent. tanstuffs such as Myrabolans or *Divi Divi*,—both of them crushed without seeds,—will pack very closely, into small compass and I could not recommend the manufacture of Extracts in such cases, except when the presence of insoluble particles was objectionable as, *e.g.*, in the application of the tannins to textile fibres.

(3) On the other hand, presuming a tanstuff to contain say,—20 per cent. tannin to 4 per cent. non-tannins, such an Extract should theoretically yield tannin 66·7 per cent. and non-tannins 13·3 per cent., with 20 per cent. mois-

ture; or 70·8 per cent. tannin and 14·2 per cent. non-tannins with 15 per cent. moisture. The probability is that the actual percentage of tannin in the solid extract would be between 60 and 65 per cent. and this amount from a 20 per cent. tanstuff would indicate that the manufacture of extract from the raw material should be very seriously considered, and studied with a view to ascertaining the sort of leather yielded both by the raw material and Extract respectively. Generalising from the above, (an analysis of *Hopea parviflora* bark actually had such figures of analysis, and yielded a solid extract with 60·5 per cent. tannin in a small preliminary solidification test conducted sometimes ago without the advantages of the new Plant), I would say that only when the ratio, $\frac{\text{non-tannin}}{\text{tannin}}$ is less than unity (1), the question of the possibility of extract manufacture begins to come into contemplation, and the higher the proportion of tannin, the more is this the case,—which brings me to my fourth principle.

- (4) There are certain tanstuffs,—woods, etc.,—containing a very small proportion of tannin and a still smaller proportion of non-tannin, *e.g.*, Oak wood, the wood of *Xylia dolabriformis*, etc. With a content of about 6 per cent. tannin this latter material could not be regarded as a direct tanstuff, but given adequate leaching facilities, there is no reason why, it, with a low percentage of non-tannin, should not come in, from an extract point of view. On the other hand, there are tanstuffs such as *Karunda* leaves with, say, 10 to 12 per cent. tannin, and 23 to 25 per cent. soluble non-tannins. A 10 per cent. tanstuff having a peculiarly valuable action on leather owing to its non-tannins *could* come into consideration for direct application in the tannery. But the theoretical strength of an extract made from this, concentrated to 20 per cent. moisture, would only be approximately 23 per cent. tannin, and 57 per cent. soluble non-tannins; and in my experience no commercial firm cares to look at a solid extract with less than 50½ per cent. tannin,—unless in quite exceptional cases.

- (5) Such an exceptional case where an extract with less than 50 per cent. tannin *might* find favour, is where this is manufactured from cheap low-grade material at a minimum cost, the manufacture resulting in the leaving behind of objectionable characteristics of this cheap raw material. An instance of this sort has been the successful manufacture here, on an experimental scale of a good-coloured solid Myrabolan Extract containing upwards of 38 per cent. tannin from a practically valueless refuse of Myrabolan 'kernals,' dust obtained in crushing, and spoiled 'nuts,'—one-third of each.

As Tannin Extract low in tannins might also come into demand, on account of valuable properties as regards the action of its non-tannins on the pelt. Then there is the case of the various Oak extracts on the market, which, though not particularly high in tannin, have nevertheless a very special weight giving property: probably due in part to the non-tannins, though the main factor here would appear to be the power of the tannins to deposit bloom within the pelt. In several of the Himalayan Oaks, the tannin is but little in excess of the non-tannins, but the well-known properties of European Oak bark,—on the average much less rich in tannin than the Indian barks I have tested,—would fully justify experiments in extraction of these barks. The same applies in even a greater degree to the various Oak woods, extracts of which are so largely used in Europe at the present time.

Speaking quite generally, extracts are costly to manufacture and do not give as good a colour as raw tanstuffs, hot leaching, as a rule, giving worse colour than cold. I expect that our experiments will show us that such colours as are developed during concentration may be modified by the judicious admixture of other materials in the leach,—a course to be greatly preferred to chemical treatment. But where long distance carriage is involved and the extract represents a proportionately great concentration of tannin as compared with that in the raw material, my present opinion is that there,—and perhaps there alone,—natural extracts will hold their own in the generality of Indian tanneries, though there may, of course, be special cases, as, *e.g.*, in the rapid drumming (loading) of hides where the Extracts may be turned to good account in a tannery otherwise depending on raw tanstuffs.

From purely theoretical deductions based on the analysis figures quoted below, the following tanstuffs would seem to recommend themselves for experiment in extract manufacture:—

Tanstuffs.	Tannin.	Non-tannin.	Theoretical maximum possible percentage tannin in Extract with 15 per cent. moisture.
			Per cent.
<i>Hopea parviflora</i> (Malabar Ironwood)	21.71	4.69	70
<i>Terminalia myriocarpa</i> mature bark	24.00	11.00	58
<i>Dhawa</i> (<i>Anogeissus latifolia</i>) Sumac	30.00	15.00	57
<i>Kahua</i> (85 per cent.), <i>Dhawa</i> (15 per cent.) mixture	23.20	12.45	55.3
<i>Kahua</i> (<i>Terminalia arjuna</i>) bark	22.00	12.00	55
<i>Rumex hastatus</i> (Indian canaigre) root bark. . .	23.18	12.79	55
<i>Rhus mysorensis</i> (a Sumac shrub) bark . . .	19.51	11.43	54
WATTLES.			
<i>Acacia decurrens</i> bark	43.27	8.22	71
<i>Acacia dealbata</i> bark	17.94	7.18	61
MANGROVES.			
<i>Carapa obovata</i>	41.00	11.00	67
<i>Ceriops roxburghiana</i>	27.73	8.15	66
<i>Ceriops candolleana</i>	22.60	10.72	58
<i>Brugiera caryophylloides</i>	18.41	10.49	54
<i>Heritiera fomes</i> (Sundri)	7.34	4.36	53

It may be mentioned that Mangroves are, as a rule, very variable as to their tannin content, and I should take the last three in the above list, as being distinctly below the average for the respective species. A good fresh average sample ought, therefore, to give

rather higher figures of 'possible tannin content' in the Solid Extract.

Oaks.—Certain Oaks and Chestnuts of the Himalayas particularly recommend themselves; for instance:—

Tanstuff.	Tannin.	Non-tannin.	Theoretical maximum possible percentage tannin in Extract with 15 per cent. moisture.
			Per cent.
<i>Quercus fenestrata</i> mature bark	15.85	8.44	55
<i>Quercus incana</i> , mature bark	13.01	6.30	57
<i>Quercus incana</i> , wood	5.00	4.00	47

A small sample of branch bark of *Quercus semecarpifolia* gave, on analysis, the extraordinary figures of 23.65 per cent. tannin, and 2.63 per cent. non-tannins. This would indicate a possible maximum tannin-content in a Solid Extract, of 76 per cent., but this excellent possible figure was not borne out by analysis of a larger bulk of the bark received later, and I therefore have not included the figures in the table.

The actual percentage of tannin in an Extract always falls short of the theoretical maximum. This is due to changes which take place during extraction and concentration, and the extent to which these changes occur is obviously one of the factors determining whether a raw tanstuff should be converted into Extract or not.

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